

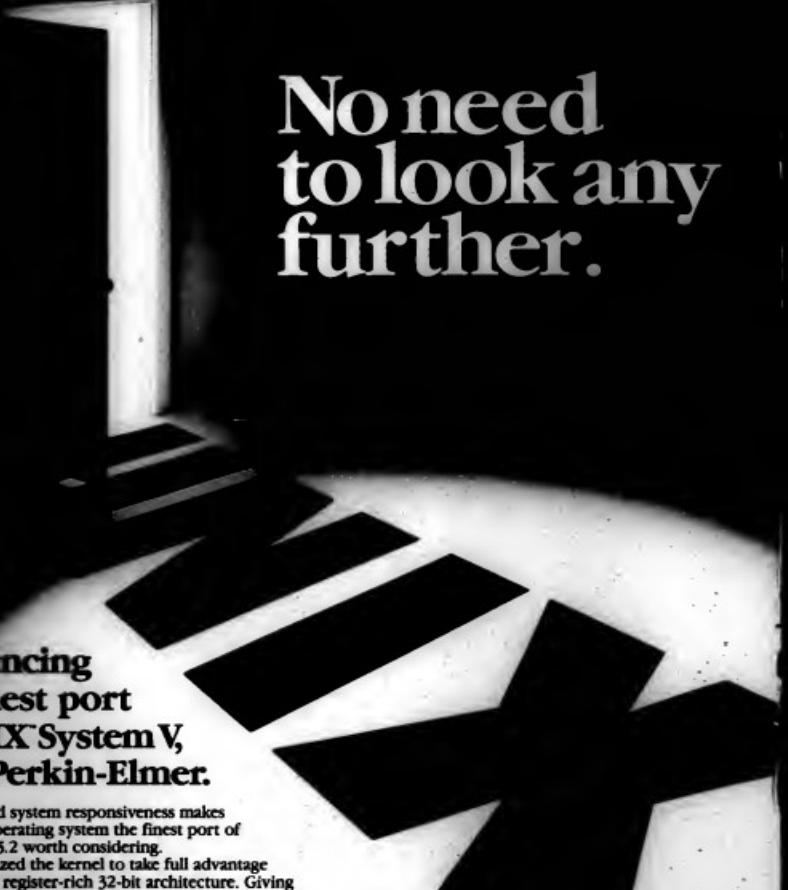
COMPUTERWORLD

SEPTEMBER 26, 1984

VOLUME 18, NUMBER 398

UNIX UNBOUND:
Getting Over Shell Shock
Coming Next from AT&T
Who's Selling Software?
Up and Running on Mainframes
Plus: Jean Yates, Bob Marsh,
David Fiedler and More

LIBRARY IN INCLINGHAM
IS A GOOD IDEA TO
IF YOU ARE
MAINFRAMES 3029C 50223
ON MARCH 5



No need to look any further.

bouncing the finest port of UNIX System V, from Perkin-Elmer.

Unprecedented system responsiveness makes our XELOS™ operating system the finest port of UNIX System 5.2 worth considering.

We've optimized the kernel to take full advantage of our unique, register-rich 32-bit architecture. Giving you high job throughput on our Series 3200 superminicomputers. With data I/O throughput up to 40 MB/second.

XELOS runs on a full range of compatible, high-performance hardware. With a friendly, simplified user interface called the MenuMaker™. And a strong family of application software for office automation, decision support and data processing. All adding up to a highly productive programming and multiuser environment. So if you're serious about the UNIX system standard, why not go for the finest: XELOS, from Perkin-Elmer.

To find out more, call us toll-free. Or write to The Perkin-Elmer Corporation, Two Crescent Place, Oceanport, N.J. 07757. In N.J. call (201) 870-4712.
800-631-2154

PERKIN-ELMER

UNIX is a trademark of AT&T Bell Laboratories.
XELOS and MenuMaker are trademarks of The Perkin-Elmer Corporation.

Extra!

CW COMMUNICATIONS/INC.
Box 880, 375 Cochituate Road,
Framingham, Mass. 01701

Editor George Harrar
Associate Editor Barbara Van Scyoc
Assistant Editor Elizabeth Morris
Art Director Tom Monahan
Production Manager Marlene Stahl
Typesetting Manager Carol Polack
Photo-Up Manager Patricia Gaudette
Art Assistant Marlene Bonsu

Board Chairman Patrick J. McGovern
President W. Walter Boyd
Executive VP Lee Vidmar
Publisher Donald E. Pagan
Commodore Systems Group VP Jack Mazzoni
Group VP-Circulation Margaret Phelan
VP-Finance William P. Murphy
VP-Editorial John C. Whitmarch

Second-class postage paid at Framingham, Mass., and additional mailing offices. Computerworld (ISSN 0010-4841) is published weekly, except: January (5 issues), February (6 issues), March (5 issues), April (7 issues), May (6 issues), June (7 issues), July (5 issues), August (6 issues), September (7 issues), October (5 issues), November (6 issues), December (3 issues) and a single combined issue for the last week in December. Box 880, 375 Cochituate Road, Framingham, Mass. 01701.

Copyright © 1984 by CW Communications/Inc. All rights reserved. Reproduction of material appearing in *Computerworld* and *Computerworld Extra!* is forbidden without written permission. Send all requests to Nancy Shannon.

Computerworld subscription prices: \$2.00 a copy; U.S.—\$44 a year; Canada & So. America—\$110 a year; Europe—\$160 a year; all other countries—\$245 a year (airmail service). Computerworld Extra! single copy price: \$6.00. Prior week notice is required for change of address. Please allow six weeks for new subscription service to begin.

Computerworld can be read in 80 countries inform through University Microfilms Int'l., Periodical Entry Dept., 300 Zeeb Rd., Ann Arbor, Mich. 48106.

PHOTOCOPY RIGHTS: permission to photocopy for internal or personal use or the internal or personal use of specific clients is granted by CW Communications for libraries and other users registered with the Copyright Clearance Center (CCC), provided the base fee of \$3.00 per copy of the article, plus \$.50 per page is paid directly to Copyright Clearance Center, 21 Congress Street, Salem, Mass. 01970.

Permission to photocopy does not extend to copyrighted articles followed by this symbol: \$

POSTMASTER: Send Form 3579 (Change of Address) to Computerworld Circulation Dept., Box 880, 375 Cochituate Road, Framingham, Mass. 01701.

Computerworld Extra! is a member of the CW Communications/Inc. group, the world's largest publisher of computer-related information. The group publishes 53 computer publications in major countries. Nine million people read one or more of the group's publications each month. Members of the group in North America: Computerworld/Argentina, Canada's *The Computer Connection*; Australia's Computerworld Australia, Australian Micro Computer, Australian PC World and Directories; Brazil's DataNews and MicroWorld; China's China Computerworld; Denmark's *Computer*; France's *Le Monde Informatique*, *Goldan* (Apple) and *OPC* (IBM); Germany's *Computerwoche*, *Microcomputerwelt*, *PC Welt*, *Sophos* (Apple); CW *Businessweek*, *Computer Business* and *Computerweek*; Italy's *Computerworld Italia*; Japan's *Computerworld Japan* and *Perco ComputerWorld*; Mexico's *Computerworld/Mexico* and *ComputerMundo*; Netherlands' *Computerworld Beeldt* and *WordDienst*; Norway's *Computerworld*; Norway's *MicroData*; Saudi Arabia's *Computerworld*; Spain's *Microinformatica/Expres* and *Micro Software*; Sweden's *ComputerShades*, *Mikro Data*, *Mikro Headstart* and *Systema PC World*; the UK's *Computer Management*, *Computer News*, *Computer Business* and the U.S. *Computerworld*, *Hot CoCo*, *icCoder*, *InfoWorld*, *MacWorld*, *MicroMarketsWorld*, *Microcomputing*, *PC World*, *Rexx*, *72 Magazines* and *80 Micro*.

Unix is a trademark of AT&T Bell Laboratories.

5 USERS & UNIX

By Robert Byers

Getting over shell shock is the first task of the new user. Welcome to the world of "awk" and "grep."

10 "YOU WANT UNIX? WE'VE GOT UNIX!"

By Glenn Riffkin

Willingly or not, major hardware vendors now run Unix. Page 17 — A sampling of software.

18 YES, IT RUNS ON MAINFRAMES

By Donald O'Shea

Amdahl Corp. wants you to know Unix can and is operating on some of the world's largest computers.

23 THE UNION OF C AND UNIX

By P.J. Plauger

C was born at a time when Unix was ripe for recasting in a higher level language. It's not quite a perfect marriage.

27 CAN THE HOLES BE PLUGGED?

By Glenn Kowack and Dave Healy

Unix wasn't designed with security in mind. But that security is a must for an operating system in a commercial environment.

29 THE SEARCH FOR A STANDARD

By Robert Marsh

How can Unix be a standard without a single, standard version of Unix? A user group offers a solution.

32 YATES ON UNIX

By Jess Yates

Thoughts, projections and predictions from a pioneer in Unix market research.

41 WHERE'S THE APPLICATION SOFTWARE?

By Mark Ursino

Software packages are tough to find. But you need to make the choice before locking yourself into a particular Unix version.

49 UNIX TO UNIX NETWORKS

By Jon Gruff

The Network Research, Newcastle, Plexus and Sun Microsystems approaches to local-area networks.

55 BEST BOOKS

By Jim Joyce

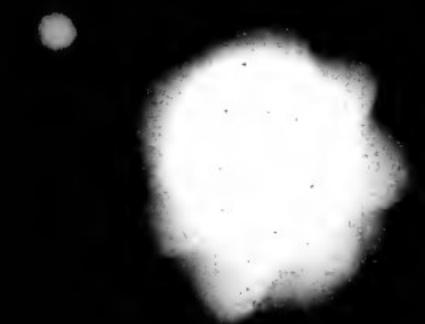
There's Weinberg and Groff for managers, Bourne for programmers and Kernighan and Pike's classic for everyone.

59 THE USER EXPERIENCE

- What Unix can do, by Beverly Dyer, T.P. Young, K.G. Ramakrishnan
- Unix runs the office, by Michael Hessler
- Unix gateways, by Fred Sutterlin



Unleash
The True Potential
Of The 68000/UNIX Environment



PHILON FAST/COMPILERS

PHILON REDEFINES SPEED

A true compiler so fast, your concept of speed will never be the same. A true compiler that redefines speed and unleashes the ultimate power of the 68000. It powers UNIX® to its fullest potential.

PHILON FASTCOBOL, PHILON FASTBASIC-C, PHILON FASTC/C, and PHILON FASTC languages, software technology and customer support for you by Philon.

Execution Speed And Flexibility

PHILON FASTCompilers redefine performance in benchmarks. Up to 47 times faster. Look at PHILON FASTCOBOL (see benchmark chart) — and judge for yourself.

Flexibility. It's built in. PHILON FASTCompilers are specifically designed to free programmers from artificially-created constraints such as 64K program or data file size limitation and allow efficient development of highly optimized application systems. And, PHILON FASTCompilers all share a common records manager to support indexed sequential, random and sequential file organization.



Thorough Product Testing, Complete Documentation

You demand reliable and efficient compilers. Our quality assurance commitment delivers it. We test thoroughly, check ourselves at least twice; only then have we met our own high-quality specifications. And, you receive accurate Philon documentation. It's clear and easy to read, making compiler installation and use productive and hassle-free. It's part of The Philon Approach™.

Responsive Customer Support

Responding professionally and promptly through a series of reports, bulletins and a telephone hotline, Philon keeps you in touch by providing information and assistance. Our customer support system was

established with your needs in mind. This is what you will come to expect from Philon.

Elements Of Performance

- No 64K limit on program or data file size
- Interactive testing and debugging of source code—The Phi-Analyser™
- Link program modules in either the same or different languages
- Ability to optimize programs for speed or size
- Mathematical versatility to perform calculations using either BCD or IEEE
- Execution of calculations at a level of accuracy found only in mainframes (PHILON FASTBASIC-C achieves an outstanding accuracy level of 9.0×10^{-9})

BYTE Magazine Sieve Benchmark

RYAN-MCFARLAND COBOL

MICRO FOCUS HIGH
PERFORMANCE LEVEL II COBOL

PHILON FASTCOBOL

In a comparison of Ryan-McFarland COBOL 1.0, Micro Focus COBOL 2.0 and PHILON BASICCOBOL 1.0 using the BYTE Magazine sieve benchmark the results are conclusive: PHILON FASTCOBOL executes the benchmark 24 times faster than Micro Focus and 47 times faster than RMACOBOL. (System configurations: 68000/UX/10MHz/1M wait state.)

Unleash the true potential of your 68000/UNIX system, call Bob Glidensberg at (212) 807-0303, or fill out the reply coupon today.



Philon, Inc.
6-1 Avenue of
the Americas
New York, NY 10011
(212) 807-0303

I'd like to learn more about PHILON FAST/Compilers.

Name	()	
Title	Phone #	
Company		
Address		
City	State	Zip
Computer(s)		
Operating System(s)		

CW9-35

PHILON FAST/COMPILERS . . .

Your Concept Of Speed
Will Never Be The Same.

* UNIX is a trademark of AT&T Bell Labs. ** RMACOBOL is a trademark of Ryan-McFarland Corp. ¶ CBASIC is a trademark of Digital Research, Inc. ||| MMASIC is a trademark of Microsoft, Inc.



"I wish to heck
someone would come up
with SNA and BISYNC
gateways for my UNIX
multiuser system."

"Someone has.
UniPATH* by Pathway Design.
Now save your pencils
and call 800-343-0515.
Or send this coupon."

I'm running out of pencils. Send me all the information
you have on UniPATH. Soon.

Name _____

Company _____

Address _____

City _____ State _____ Zip _____

Phone _____

CWURB/94

PATHWAY

Pathway Design Inc., 177 Worcester Street
Wellesley, MA 02181 • 800-343-0515
(In Massachusetts, 617-237-7722)

*UniPATH Gateways for UNIX III, UNIX V and XENIX™ operating environments.
UNIX is a trademark of Bell Laboratories. XENIX is a trademark of Microsoft Corporation.

THE NEWSLETTER FOR THE COMPUTER COMMUNITY

COMPUTERWORLD

~~\$4.00~~

\$39.00

With this order form, you pay only \$39.00
(just 76¢ a week). That's a \$5.00 savings off
the annual rate. So, invest in the best.
Subscribe today!

Complete this form and mail in the postage-
paid envelope or use your charge card and
call, toll-free: 1-800-343-5730.

As a weekly newspaper COMPUTERWORLD
gives you thorough and timely coverage
of news and ideas in computer usage. Unlike
magazines, COMPUTERWORLD covers
hundreds of relevant new items each week.
But beyond the "news" you get much more:
weekly "In-Depth" articles, monthly
"Special Reports" on selected topics,
special focus issues and more.

Order today! Call 1-800-343-5730.

MAIL-IN ORDER FORM

COMPUTERWORLD
Subscriptions

Please send me COMPUTERWORLD for one year. RATES: United States \$49;
Canada, Central & South America \$110; Europe \$165;
All Other Countries \$245 (Airmail Service)

Special Introductory Offer
Only \$39.00 Save \$5.00

Check Enclosed.

Am Ex B&V/Visa MC

MC Only List four digits above your name.

If charge we must have

cardholder's signature

Expiration

Date

First Name _____

Middle Initial _____

Surname _____

Mr _____

Ms _____

Other _____

Year Born _____

Month Born _____

Sex _____

Company Name _____

Title _____

Industry _____

Address _____

City _____

State _____

Zip Code _____

Address shown in: Business Home

Check here if you do not wish to receive promotional mail from Computerworld

Check here if you're interested in receiving information on Computerworld's Index

Put old label or label information here—
and new information above.

I'm already a subscriber,
but I'd like you to change my:
 address industry
 title other

COMPUTERWORLD

THE NEWSWEEKLY FOR THE COMPUTER COMMUNITY

CIRCULATION DEPT., 375 Cockshutt Road, Rte. 30, Box 907, Framingham, MA 01701-9075

Detach here, moisten and seal envelope securely before mailing.

INTERESTS/Hobbies (check box)

- Computer/Calculator/User
- Financial Services/Finance
- Medical/Law/Executive
- Manufacturing
- Business Services/Impact (PR)
- Government/Political
- Public Utility/Transportation/Systems/Resource
- Manufacturing/Construction/Petroleum
- Marketing/Commerce/Personnel/Training
- Other User

Business (check box)

- President/Owner of Computer, Computer-related
- Systems/Peripherals
- Computer Service/Business/Software/Planning/Consulting
- Computer/Peripheral/Device/Component/Reseller
- Other Vendor

Education (check box)

- President/Chairman/Partner/General Manager
- Executive VP
- Executive Vice President/Officer
- Director/Manager/Superintendent/President/Secretary/Administrative Staff
- Systems Manager/Systems Analyst
- Applications Manager/Programmer
- Program/Line Manager/Analyst
- Project Manager/Supervisor
- Data Center/Network Manager/Analyst
- Help Desk Manager/Supervisor
- Consulting Manager
- MIS Manager/Systems Manager
- Technical Support/Documentation/Training
- Other

Employment (check box) at the top

- Sport or equipment which you or personally enjoyed either as an amateur or professional
- Musician
- Actor/Actress
- Entrepreneur/Small Business Computer
- Computer/Computer Services
- Computer/Computer Components
- Other Automation Systems

Extra!

USERS OF UNIX

Unix is terse and jargony, a hacker's delight. It is not really a user's operating system.

By Robert Byers

Unix could well be called the Once and Future Operating System. Widely used since the mid-1970s, it seems destined to become the operating system standard for upscale micros as well as many larger computers.

Developed at AT&T's Bell Laboratories in 1969, Unix was a multilayer, multitasking, interactive system at a time when many computers were still batch processors fed by punched cards. Unix very rapidly became a darling of the computer science community, and by 1974, there were more than 600

Unix installations in place.

Although the number of Unix users continued to grow slowly but steadily, it appeared for a time to be just one more system whose time had passed. Many data processing managers were not convinced that AT&T was serious about supporting its operating system.

With the microcomputer explosion of the early '80s came a handful of supermicros based, for the most part, on the Motorola, Inc. 68000. One attraction of the supermicros was that they had the CPU power to be multilayer, multitasking and interactive. In fact, if they didn't, there wasn't much of a market for them. The supermicros needed an operating system as well as application software to become commercially viable.

Most hardware manufacturers cannot afford to develop and maintain their own software. So it seemed only natural they would turn to Unix. It was there. It worked. And there was a library of readily available software. Then, in the spring of this year, AT&T announced its own line of Unix-based

supermicros, the 3B series. This commitment is sufficient to ensure Unix will become the operating system standard for the supermicros.

As an operating system, Unix controls the operation of the hardware. It is responsible for managing the computer's resources, memory, CPU and disk storage as well as the interface to external devices such as terminals and printers. When more than one user is on the system, it allocates resources to users and arbitrates conflicts. It keeps track of what is stored on the disks and where disk files are located. It provides the interface between application programs and the hardware.

Unix requires a relatively large system by microcomputer standards. About the minimum usable configuration would be the IBM Personal Computer XT. Unix itself needs about 1.5M bytes of disk space. This space takes care of the core operating system (called the kernel), together with associated utility programs.

A good part of the value of Unix lies in these utility programs. They give the application programmer a



CELEBRATE!

and insert
the system
compiler that generates

©1985 Gould Inc. All rights reserved. David Systems, G-1000,
AppleTalk and the Apple logo are trademarks of Apple Computer, Inc.
Macintosh is a trademark of Apple Computer, Inc.
Intel is a registered trademark of Intel Corporation.
Lisa is a trademark of Apple Computer, Inc.





Motorola/Four-Phase introduces The 6000 Series—a new milestone.

A milestone for new standards in office information systems from the company that started it all.

From the moment Four-Phase introduced the world's first all-LSI computer in 1970, we have consistently presented the industry with innovative hardware and software products to help make business more profitable and productive.

Today, as a member of the Motorola Information Systems Group, Four-Phase once again unveils another milestone in information processing—the new 6000 family of office information systems. Compact, powerful

processing units and flexible, capable software have been fused together into a family of systems that deliver maximum results today, with substantial expansion capabilities for tomorrow.

Technology for the real world.

Motorola/Four-Phase systems are tough enough and smart enough to deal with the real world—where speed, power, and reliability in a multi-user environment are prime considerations. The new 6000 systems feature the high-performance 32-bit Motorola 68010 CPU and an operating system derived from UNIX® System V under license from AT&T. We created





integrated system software that combines these two industry standards into a powerful, multi-user, multi-tasking environment that can stand up to practically any application.

There are two systems in the 6000 family. The 6300 supports 1-8 users, making it perfect for the smaller user or a remote office. The 6600 is a high-performance system designed to support up to 128 users. Both systems offer complete and integrated solutions—whether they're working in an operations-oriented environment where efficiency and precision are needed, or a results-oriented environment where flexibility and quality are key.

Service and support to match our technology.

At Motorola/Four-Phase, our commitment to you goes beyond providing quality, high-performance hardware and software. Support is just as important. Our award-winning Customer Support Operation is staffed with over 1,400 customer support specialists in over 175 cities across the nation. One phone call to our

Operations Center will ensure prompt response from the nearest available specialist. And you can call the Center 24 hours a day, 365 days a year.

If you're a DP/MIS manager or OEM, find out what the latest milestone in office systems can mean to you. Contact Motorola/Four-Phase today at 1-800-528-6050, ext. 1599. In Arizona, call 1-800-352-0458, ext. 1599. Or write us at 10700 North De Anza Blvd., M/S 52-3B1, Dept. S., Cupertino, CA 95014.



MOTOROLA Four-Phase Systems

See us at Unix-Expo Booth #618.

Motorola and are registered trademarks of Motorola Inc. Four-Phase is a registered trademark of Four-Phase Systems, Inc. "UNIX" is a trademark of AT&T Bell Telephone Laboratories, Inc.



1984

Motorola/Four-Phase announces The 6000 Series—a milestone in productivity that delivers information processing performance today, and expansion capabilities for tomorrow.



"YOU WANT UNIX? WE'VE GOT UNIX!"

By Glenn Risskin

At least 85 vendors have introduced some version of Unix on their systems. Counting micros, minicomputers and mainframes, there are more than 250,000 Unix-based systems in place. More than 150 application software packages are available for the various Unix versions with more being announced weekly it seems.

It is perplexing to both developers and industry observers that Unix — or any operating system, for that matter — is attracting so much attention in the end-user market of today. Bill Joy, developer of the Berkeley 4.2 version of Unix, has said, "Operating systems are like underwear. No one really wants to look at them."

In Unix's case, however, everyone is looking. And the major vendors are acting, conceding that Unix-based machines are required in their product lines. The question is not so much when Unix will become king, but how much of the kingdom it will claim.

The following sample shows how some major vendors are integrating Unix into their product lines.

AT&T
The recently unshackled telephone company is pushing its operating system as not only the foundation for its own product line but also the standard for the industry. Prior to divestiture, AT&T did little to promote Unix except to give it for a nominal fee (\$200) to universities. Unix was usually the first operating system young computer whizzes touched, and today there are thousands of C-level programmers who would rather turn in their keyboard than give up their Unix.

According to Stuart Mencher, director of data systems marketing for AT&T Information Systems, the company thinks Unix is simply the best operating system available and now AT&T is positioning itself to make it a de facto standard. Toward that end, the company introduced Unix System V Release 2, the latest upgraded version, and is licensing it throughout the industry.

AT&T also has signed cooperative agreements with such firms as Microsoft Corp., Ashton-Tate, Inc. and Digital Research, Inc. (for more microcomputer application software offerings) and Motorola, Inc. (for

the portability of Unix to 68000-based microcomputer systems). System V is also the basic operating system for AT&T's 3B line of computers, introduced earlier this year.

"We are positioned to be a leader in this market, and as the inventor of the product, we have to be the best," Mencher said. "That's a double-edged sword, because there are a lot of others out there competing with us."

Ironically, AT&T introduced its personal computer offering, the 6300, as a system based on Microsoft Corp.'s MS-DOS. Unix was conspicuous by its absence. Speculation was that AT&T showed market savvy by not bucking the IBM Personal Computer domination. Mencher admitted that AT&T is looking at the possibility of running Unix on its personal computer (or perhaps on an enhanced workstation expected this fall). And in fact, with the PC Interface, the 6300 can access the power of Unix by linking the MS-DOS operating system in the personal computer to the 3B2 desktop supermicro.

AT&T has introduced a vendor involvement program encouraging

software developers to contact the company. "If we are interested, we will fully support the product," Mencher said. "If not, we will still list it in a directory of Unix software that we publish. We've already had more than 800 inquiries."

AT&T will also be introducing Unix on a Westinghouse Electric Corp. 32000 chip, which will offer better price/performance, according to Mencher. "The WE32000 will set us apart," he said.

IBM

IBM put its imprimatur on Unix when it announced its Unix-based Personal Computer Interactive Environment (PC/IX) operating system in January. Developers for IBM by International Systems Corp. of Santa Monica, Calif., PC/IX is based on Unix System III.

On smaller systems, CP/M and MS-DOS were adequate. But when the need for multiuser, multitasking power became necessary, it was easier to adapt Unix than to stretch CP/M.

PC/IX, designed for the Personal Computer and Personal Computer XT, contains Unix's standard command language with a full menu interface that reportedly makes it easier for single users to use and maintain.

PC/IX can reside with other operating systems on a fixed disk so that more than one system is available to

the user. The product is reportedly able to provide programs for file transfer to and from IBM's PC-DOS personal computer.

Relatively unknown is the fact that PC/IX is not IBM's first foray into the Unix world. IBM Instruments developed a version of Xenix (Microsoft's Unix look-alike) two years ago

for the IBM 9000 processor; and another version of Unix for the Series/1 minicomputer was made available only to a limited IBM customer set.

IBM has also announced a limited offering of Unix for the VME series specifically — which is available to customers with "special requirements."

It is the same version of Unix as on the Personal Computer, expanded to the VME environment.

In August, IBM announced its Personal Computer AT, an Intel Corp. 80286-based high-end multitasking personal computer. At the same time, the company announced the IBM PC Xenix reportedly allows two additional terminals to share the AT's processing power in either a multi- or single-user environment.

Though the company wouldn't speculate on the future availability of Unix for IBM's entire product line, Pat Kearney, director of programming for IBM's Information Program Services group, acknowledged that Unix has become a requirement in today's market and the company is developing other Unix products.

"We are actively supporting Unix," Kearney stated. "Our customers are asking for it, and we see it as a significant business opportunity."

Kearney pointed out that IBM's version of Unix is "very much a real implementation of Unix; very pure and close to the standard Bell Unix." Bob Blake, manager of product development for PC/IX, added that though Unix may not be perfect, "unfortunately, IBM has gone a long way to make it clean and crisp. Someone without Unix experience may find it hard to use," Blake admitted.

Thus far in beta test sites, efforts to port applications over to PC/IX have worked relatively well, according to Kearney. IBM has also brought out a Fortran 77 compiler and offers other applications such as Interactive's Inmail, Inset and PCNet (a file transfer program).

In fact, said Kearney, IBM worked closely with AT&T on the PC/IX development. Far from locking horns on AT&T's home turf, the two enjoyed a "very cordial and productive" relationship.

Analysts tend to agree that with IBM and AT&T behind it, Unix can't fail. Both Kearney and Blake are wary of placing standard status on Unix just yet, however. "I don't think the perfect operating system has been created yet," Blake said.

"Unix has some unique strengths, especially in that it has been ported across a broad range of processors. But there are still a lot of requirements that the marketplace will address."

DIGITAL EQUIPMENT CORP.

Considering that Unix was created in the 1960s on DEC's PDP-7 mini-computer, the Maynard, Mass.-based computer giant decided it was high time that it treat the Unix market seriously. DEC entered the first test system with the VTM-11. VTM-11 was, based on Version 7, with enhancements for application development and porting.

Earlier this year, DEC renamed VTM-11 as Ultrix-11 and introduced Ultrix-32 for its VAX line of superminis. Ultrix-32 is based on the Berkeley 4.2 version of Unix, and on Sept. 11 the company announced a subset available for the recently

We're the expand, expert, the group guru.
We're making multi-user dreams come true, bringing compatibility closer to reality and working
miracles in portability.

CGA is the power behind the power behind UNIX® and we're a major player in C.
Our contribution in UNIX development is one of the best kept secrets around. But we believe if you think big,
you'll have to talk loud. The good news travels.

Over the last 15 years we have established ourselves as the preeminent source of software
consulting. And for the last few years we have had our minds behind UNIX. We have
professionals in residence on the UNIX frontier designing solutions in:

- Office Automation
- PBX Technologies
- Networking
- As a client
- Call on us for UNIX software design and support and you get resident experts who can see all
the way to the future. You get the best C cards in the country to structure your international
- network or work up your graphics capability.
- If software consultants must carry a card with CGA's name on it, you can be assured that they have
passed some of the most stringent criteria in the business.
- As a member of our team
- Join our team of UNIX specialists and you'll learn by association with great ones. We do, you do,
believe in the importance of a continuous learning process. Our in-house courses and fully
supported university programs will keep you on top of your technology—and the knowledge of
one of the best—will make you better.
- See us at Booth #424 at the UNIX EXPO on
October 16, 17, & 18.
- Talk to the company that knows how to play success in C major. Call or write
CGA Computer, Inc. at:
25 Commerce Drive
Cromford, NY 10716
(201) 272-7950
We are an equal opportunity employer
"CGA is a registered of AT&T Bell Laboratories

369 Lexington Ave.
New York, NY 10017
(212) 853-0900

c g a

WE'RE WILLING TO LIVE WITH THE CONSEQUENCES OF HAVING XENIX ON OUR 286/310.

We're delighted to see the future catching up with our past. When we designed our Xenix® 286/310 multiuser, multitasking supermicro system, we felt confident that the industry standards would fall neatly in step with our own standards.

Like they just did.

So now dozens of independent software vendors will be publishing stacks of new software for machines using Xenix on the 286. Machines like ours.

But because our supermicro was introduced last year, we can already offer OEMs a choice of our own and ISV software that's here now and ready to run.

There are applications programs like spreadsheets, inventory, accounting, manufacturing and mainframe to micro connections. There

are productivity tools like forms and menus. And high level languages like COBOL, C and BASIC.

The Xenix 286/310 is designed for use by 4-12 people. And whatever tasks those people give it, the 286/310 races through them all at minicomputer speed.

It's perfect for OEMs who need to get to market fast. Not only because it has an existing software base, but also because it's an open system.

From chips to board to box, it's built on industry standards. Like Xenix, the 286 microprocessor and MULTIBUS. That means, like all Intel systems, the 286/310 is easy to configure and easy to upgrade.

So you'll be able to adjust to the future's changing

markets as fast as you can adjust to this one.

For all its openness, multitasking, multiuser capabilities, and software, you can still get the 286/310 at a microcomputer price.

To find out how to take advantage



of this changing market today, call us toll free at (800) 538-1876. In California, call (800) 672-1833.

Or write: Intel, Lit. Dept. S-13, 3065 Bowers Avenue, Santa Clara, CA 95051.

And be prepared to live with the consequences.

introduced Microvax. In June, DEC introduced Pro/Venix, a Version 7 Unix developed by Venixcom, Inc., and the DEC personal 360 microcomputer.

The Venix product for the DEC Rainbow personal computer is currently in the works, according to Bernie Toth, DEC's marketing manager for Unix.

Toth pointed out that

Venix and Ultrix-11 are very

similar in that they are

both derived from Version 7.

He also noted that applications running on Ultrix-32 can be ported to VMS, DEC's

proprietary operating system for the VAX.

DEC has also introduced VNX, a program for product development which integrates Unix into the VMS environment for software development work. In that vein, the company developed the VAX-11 C programming language to support optimized, sharable, position-independent code in the VAX/VMS environment.

DEC's interest in Unix has been growing over the past six years since the company started to track the operating system's progress, Toth explained. Since AT&T is DEC's largest customer, it was important to monitor the company's direction. DEC decided more than a year ago to support Unix on the open market.

"It was not a defensive move," Toth said. "Our customers actually demanded Unix. But that wasn't clear until just recently. In 1982, there were only 25,000 Unix installations. By 1983, that had grown to 100,000. That represented a significant market force."

Toth believes that it was the advent of the supermicro that was the boon to Unix. On smaller systems, CP/M and MS-DOS were adequate; but when the need for multuser, multitasking power became necessary, it was easier to adapt Unix than to stretch CP/M.

DEC chose to employ Version 7 (with Berkeley enhancements) rather than follow

AT&T's System V because AT&T, according to Toth, is more interested in the office automation market — to which System V is more suited — while DEC has no plans for Unix there. Toth pointed out that DEC is quite satisfied with its All-in-One system for office automation and sees Unix as appropriate for its scientific and engineering customers.

The major focus now for DEC is getting third-party developers to produce application software for Unix. "It's a new phenomenon," Toth said. "Customers are asking for an operating system; they're asking for Unix."

WANG LABORATORIES

Wang is not particularly interested in seeing Unix become an industry standard.

On the other hand, the company felt it could no longer ignore the operating system altogether.

In March, Wang started shipping UVS, an operating system environment that integrates Unix System V software with the Wang VS operating system. This attempt to give customers "the best of both worlds" at the very least puts Wang in the Unix market, although it is not a ringing endorsement.

Aaron Zornes, Wang's

manager of product marketing for software, said that the company intended to offer the strongest programming capabilities of Unix to its customers. For virtually all other applications involving screen and data management, Wang believes its VS operating system is superior.

Nonetheless, Zornes insisted that Wang's entry into the Unix market was not a defensive one. "Unix is a commodity," he explained. "We do a lot of business with the fed-

eral government and with the best operating companies. Both of those areas have large investments in Unix. We wanted to open our machines to run any software our customers need without forcing them to buy another piece of hardware."

Though Unix is not currently available on other Wang product lines, UVS represents a strong commitment on Wang's part, Zornes said, since the VS system is the company's premier product.

With UVS, users can reportedly access both native VS and Unix facilities from the same workstation and change from one environment to the other with a single command. Wang is expected to announce a multiterminal, multitasking personal computer running System V Unix within the next few weeks.

UVS also includes a Unix-to-Unix file transfer program, C, Fortran 77 and Rasterfor compilers, Programmer's

complexes turn to UNIX. Systems. Different machines to different computing needs, different requirements for applications will translate to different computing environments. The better able you'll be to compete in the industry, the more you'll benefit from the UNIX System. From AT&T. And that's a great opportunity. It's a golden opportunity to get involved now with a bright,灿烂的未来.

profits portability.

For applications software written for UNIX System V

Wang offers a number of services designed to help you develop and sell the most marketable software for micros and

HP plans to announce in October or November a personal computer running only Unix.

Workbench, a software and management facility, as well as the troff/roff utilities for text and document editing, formatting and typesetting. Though Wang added sev-

eral layers of menus where appropriate, UVS retains the basic shell of System V. According to Zornes, many vendors opted for System III or Version 7 simply because

they had products out before AT&T announced support for System V.

Wang's development work began later, and it seemed to make sense to follow AT&T's lead.

Wang's target market within the government and Bell operating companies are those "who require the ability to port Unix applications and are striving for the compatibility Unix is commanding to offer," Zornes said.

Despite Wang's Unix of-

fering, it is clear the company is less than thrilled with the commodity operating systems such as MS-DOS, CP/M or Unix.

In fact, Wang presses the point that perhaps the best thing about its Unix offering is that it allows access to Wang's own word processing, relational data bases, electronic mail and other Wang programs. "If it's widely available, why not accommodate our customer base?" Zornes

said. "We're not endorsing Unix as a standard, we're just making our machines more versatile."

HEWLETT-PACKARD CO.

HP has defined the competitive needs of companies as falling into four distinct categories: commercial data processing, office automation, manufacturing and engineering and product development. According to Doug Hartman, HP's product manager for Unix-based systems, the company plans to make Unix available in all three areas.

HP customers, however, should not hold their breath waiting. The development of Unix across HP's product line will take place over "the next few years." Currently, HP offers HP-UX, its version of Unix, only on its HP 9000 supermicro and superminis, which are aimed at the engineering and computer-aided design market. HP-UX on the 9000 was announced in November 1982 and is based on Unix System III. Hartman said that HP will be offering System V compatibility on the 9000 in early 1985.

In the commercial business and office automation markets, HP is investigating other Unix activity, but no products are ready for announcement yet. "Unix is a long way from being a good manufacturing tool, and there is a real question whether the OA market wants it at all," said Hartman. Nonetheless, HP, like other vendors, sees Unix as a potential business opportunity and will use it "to help implement our overall HP strategy."

Hartman indicated that HP plans to announce in October or November a personal computer running only Unix. The product, said to be in the \$4,000 price range, will be transportable and will incorporate new display technology. According to Hartman, it will be more powerful than Apple Computer, Inc.'s Lisa but cost less.

"There's a big segment of our audience that needs multitasking instrumentation control," Hartman explained. "This machine will run Unix for less money than anything on the market."

HP is also planning to bring out Unix on either its HP 9000 minicomputer or offer a new machine with a Unix option.

PRIME COMPUTER, INC.

Prime has not officially entered the Unix marketplace, but it will likely announce its Unix offering before year's end. The company, which has been playing catch-up in many of its markets recently, was caught somewhat behind in the Unix game. But Joanne Womble, systems marketing manager for Unix and user interfaces, doesn't

Our consultants. Our Technical Support. Our Software Support. Our training, education and assistance, even our 318 Computers to get you started.

Start from the source

We've invested millions of dollars for applications for the VMS and UNIX System V from AT&T in bringing up. And with our comprehensive support and maintenance, you'll never have to worry about your application or system ever failing again. That's why we're the best choice to serve in the computer industry.

UNIVERSITY SYSTEMS
From now on,
it's standard.

Call or write for our free catalog.

UNIVERSITY SYSTEMS
University Systems Company
100 University Street, Seattle, WA 98101
206/467-1111
Telex 327-2222
FAX 206/467-1111
TWX 910-581-1111
Cable: USYS
E-mail: USYS@WASHNET.BITNET

believe it is too late.

"Unix has generally been available on small systems. Its effect on systems over \$100,000 is still unknown," Womboldt said. "We think our timing will be right within months."

Prime has been working since June 1983 on a Unix offering in conjunction with Human Computing Resources of Toronto, a Unix systems house. When it is finally announced, Prime's offering will be available, screen by screen, from the 2230 through the 9960. Like Wang's UVS, it will be totally integrated with Prime's proprietary operating system, Prismos.

"We will offer Unix as a complement to Prismos," Womboldt explained. "Users will get both on the same system and can use both simultaneously. A Unix user can exist on

the system without any prior knowledge of Prismos."

Prime is employing AT&T's System V version of Unix, betting that AT&T's commitment to the product will lead to industry standard status.

"We're trying to give our customers straight System V for standardization and portability," Womboldt stated. "The added benefit is the value of Prime's support network."

The low-level portions of the Unix shell will be mostly provided by Prime, Womboldt explained, and the product will incorporate both the Berkeley shell from AT&T and the Berkeley C shell. Prime's implementation reportedly will offer more than 160 utilities, and its modular structure will afford access to all of Prime's languages. In addition, there will be standard Fortran 77, Cobol-74 and Pascal compilers and the troff/-

troff text editing and manipulation commands.

What Prime brings to this Unix implementation, Womboldt added, are its strength in virtual memory, its distributed file system, improved security, source-level debuggers and the opportunity to interface across Prime product lines with such offerings as the Medusa computer-aided design and manufacturing unit.

Like other major vendors, Prime was not quick to jump on the Unix bandwagon. Womboldt explained that Prime felt its own program development environment was good enough and "there was no need to migrate to Unix." As Unix gained in popularity, however, Prime's customer base started to demand it. "It's becoming a requirement," Womboldt said.

NCR CORP.

NCR brought out its Unix with the Tower line of multiuser supermicros in the first quarter of 1983.

"The trends in working with large accounts indicated a growing concern with industry standards, compatibility across the market," said Gary Horning, product manager in product planning for the U.S. Data Products Group. NCR saw a need to respond to the excitement Unix was generating and wanted to work on its potential in the business setting to make it useful throughout large corporations, not just in development.

"Unix had always been a powerful software development product, but if you sat down a manager or clerk/typist or secretary, they would tear their hair out in a matter of minutes," Horning said. "At a minimum, NCR developed five user levels: application developer, application end user, procedures analyst, system administrator, application developer and system support analyst. They are intended to satisfy everyone from analysts to managers and secretaries. The idea is to take advantage of the expertise of each level of user," Horning said.

Tower Unix also offers power failure recovery capability.

Early versions of Tower Unix were based on Version 7 and System III, and Berkeley features have been added. System V enhancements will be out soon, according to Horning.

HARRIS CORP.

Harris intends to offer Unix for all of its superminicomputer systems beginning next year. Core capability will be available in the first quarter, with more features coming through the year. By the end of 1985, users will have a full-blown Unix environment, according to Rick Maulie, director of marketing.

A significant portion of the market is looking at Unix as a de facto standard, Maulie said. "Many users are trying to standardize on Unix to protect themselves. It has become a requirement for them in planning."

Harris' goal was to develop its Unix version to achieve complete compatibility with its native operating system, VOS. The company took advantage of the fact that VOS was heavily influenced by Unix environments.

"We have a series of major customers who want to have Unix compatibility, to be able to take an application from one system to another and have it behave identically," Maulie said.

Harris claims it will be able to do just that. With its implementation, "it's not a do-or-die situation picking which operating system you want to work with," Maulie said. Users will be able to switch between the two without losing off.

When the VOS/Unix environment (VUE) is complete, Harris users essentially will be working with Unix System V, with some Berkeley version extensions.

Maulie observed that Unix is an even bigger issue for the company's prospective customers than for current ones. "In every outfit there's at least one Unix buff. Management wants to provide them with the appropriate tools," he said.

THE SERIES 1000

**The Only UNIX-Based,
PC/IX-Compatible
Multi-User, Multi-Tasking
Microcomputer System
Is Now Available
From One Of The
World's Largest Computer
Products Manufacturers.**

WHO?

SCI Systems, of Huntsville, Alabama, that's who. We've been so busy supporting the world's leading suppliers of microcomputers that we haven't taken the time to talk about ourselves.

We've delivered hundreds of thousands of 16-bit microcomputers - more than Convergent Technologies, Altos, Corvus Systems, Televideo and others combined - so we have quite a bit of successful experience to share with those who also want to be leaders.

We've introduced the SCI Series 1000 at NCC. We think it's worth a long hard look by any OEM or reseller who wants to build his business with a unique microcomputer system.

The Series 1000 is one-of-a-kind, the only UNIX™-based, PC/IX™-compatible, multi-user, multi-tasking, high performance, large capacity system ready to be shipped. Now. Yet, now.



A list of its features is impressive. Such as the 8 MHz 80186 microprocessor, over 100 MB of Winchester disk storage, up to one MB RAM, from two to eight users, networking, memory management, workstation peripheral, and many others that you can learn about by writing or calling us.

SCI has well earned its outstanding reputation for product reliability. We had to, for our customers are extremely demanding. Like NASA, the military, government agencies, and many of the largest companies in the world who always insist on the best.

You know we couldn't make computers for the people we do if we didn't make them right, in large volumes, at low cost.

SCI Systems. We've made more than a million computers for others. We're ready to make one for you.

SCI

**SCI SYSTEMS, INC.
SCIENTIFIC TECHNOLOGY DR.
HUNTSVILLE, AL 35897
205-822-4304**

Software FOR ALL SEASONS

Exhibit

This sampling of Unix-related software is meant to reflect the wide range of products coming to market as the operating system gains commercial importance. We do not imply that these products are superior to any others. All descriptions here are based on vendor-supplied information.

Applix, Inc.
Southboro, Mass.

Applix, an office software system running on Unix, is targeted for resale by large OEMs in the computer and telecommunications industry. Applix offers "active integration" to combine different types of information (text, drawings, spreadsheets and so on) into a single document.

The Intelligent Document Composer reportedly provides continuous intelligence, formating assistance during composition and control from the user to focus on editorial content rather than form. The Universal Graphics Editing combines freestyle drawing capability with ability to draw standard business charts automatically.

Onyx Systems, Inc.
San Jose, Calif.

The Onyx Office software claims to be the first integrated package for Unix-based, 16-bit microcomputers. Onyx Office combines the capabilities of word processing, electronic spreadsheet and a database manager with a menu-friendly menu shell. Options include a development system and electronic mail package.

With this product, files and data reportedly can be transferred or moved between applications. For instance, information from the word processing application and the electronic spreadsheet can be combined or transferred to the data base.

In June, Onyx introduced two multiuser micros — the floor-standing C6012V and the desktop C5012D. Onyx was the first microcomputer manufacturer to offer Unix commercially on a 16-bit micro.

Pathway Design, Inc.
Wellesley, Mass.

Pathway signed two contracts this summer to provide Unipath, a micro-mainframe product operating under the Unix-compatible operating system called Unox (from Charles River Data Systems, Inc.). Unipath reportedly will enable simultaneous connections to 32 devices in Synchronous Network Architecture/Synchronous Data Link Control and Binary Synchronous Communications networking environments. Unipath is resident on the hard disk of a 32-bit supermicrocomputer system. Pathway's

Unipath will be distributed with Charles River Data's Universe 68 supermicro and with Visual Technology's supermicro System 2000.

Visual Intelligence Corp.
Amherst, Mass.

Dataviews is an interactive graphics software system that can display dynamic data in real time in engineering, scientific and business applications. The program runs on Unix and Unix look-alikes on computers ranging from 16- and 32-bit micros and supermicros through mainframes.

Dataviews takes data such as temperature and pressure in a boiler room or current commodities prices and displays it in various formats. The user views up-to-the-second changes through multiple viewpoints on the screen.

Signatech, Inc.
Englewood, Colo.

In July, this manufacturer of computer-aided design systems upgraded Berkeley 4.2 Unix software and the Motorola, Inc. 68010 microprocessor, increasing the speed and power of the Sigma III. This system is a stand-alone 32-bit workstation capable of local-area networking and distributed processing. Users typically include architects, engineers and contractors producing design drawings and construction documents. A 68010 microprocessor and color monitor are included in each workstation.

Vision Engineering
San Jose, Calif.

The National Computer Graphics Association's May conference was the forum for announcing business and engineering graphics packages based on the industry standard Graphical Kernel System. All Visual Engineering products were written specifically for the Unix environment in the C language.

Visual-GKS and Visual-C-Chart offer systems and applications programmers graphics functions that simulate writing programs incorporating graphics. Visual-Pro-Chart enables business and users to produce easily business presentation graphics.

Logical Software, Inc.
Cambridge, Mass.

Softshell, a full-screen interface, is said to offer users direct access to even the most complex programs and packages on the market. The interface simplifies use of the hierarchical file and command structure while keeping the power of the piping and I/O redirection capabilities. The screen is divided into the window at the top and the scroll at the bottom. The window size varies according to the space needed by the command. Users can take advantage of the full-screen menu mode, which categorizes Unix commands by function with brief descriptions, or enter commands directly in scroll mode.



Dataviews displays three-dimensional vector fields in a study of effects of airflow on racing vehicles and nose cones.

Relational Database Systems, Inc.
Palo Alto, Calif.

Two separate data base management systems have been developed to run on 16-bit Unix and Unix-compatible machines. File-It! addresses the business professional or manager with an emphasis on user friendliness. The more sophisticated Informix is geared to the computer expert.

Acme Technology, Inc.
South Natick, Mass.

Digital Equipment Corp.'s Classified Software Program accepted in July Acme Technology's spreadsheet modeling program, Supercomp-Twenty. Companies using the program on their Unix workstations include Altec Computer Systems, Inc., Fortune Systems Corp., Perkin-Elmer Corp., Plexus Computers, Inc. and Onyx Systems. Supercomp-Twenty allows users to share work, access corporate data bases and transport complete models on machines from micros to mainframes.

Interleaf, Inc.
Cambridge, Mass.

The OPS-2000 extends word processing to include a top-finishing production of documents containing multiple type faces and business graphics. This model includes a 32-bit workstation, graphics controller, laser printer and proprietary software.

Lantech Systems, Inc.
Dallas, Texas

Hundreds of IBM Personal Computer applications written in Basic can be compiled to run under a Unix-compatible operating system called Unisetix. That ability is the result of an agreement between Applied Technology Corp. and Lantech, which will distribute the AT&T/BASIC compiler as an option with Unisetix. Unisetix is a "from scratch" multitasking operating system that is compatible with Unix software and was designed for networking of micros.

Emerald City, Inc.
Toronto, Canada

Emerald One combines six office tools into an integrated package for communications, information handling, decision support, document preparation and presentation, time management and systems administration. Emerald One runs on any hardware that supports the Unix operating system — Version 7, System III and System V. Scheduled shipment date is this month.



Unixix features a multitasking architecture.

YES, IT RUNS ON MAINFRAMES

By Donal O'Shea



The demand is there, right now, for another surge in Unix performance.

Laboratories and numerous other technical computer centers grew, the amount of data fed to these programs grew also, the simulation models became more complex

and the demand for a more powerful Unix engine increased. The supermini was the answer to this call — in particular, the VAX-11/780

bly 2,000 VAX-11/780s running Unix today, and the number is growing rapidly.

The individual applications are still multiplying in size and complexity. The circuit simulator, written in 1977 to run under Unix on the PDP-11 has been extended again and again. The circuit, which may have started in life as a printed circuit board with a fistful of discrete components, is now a single, very large-scale integration (VLSI) chip with

thousands of integrated components. The simulator can no longer run on a PDP-11 — it would take 40 to 50 hours to execute. Even on a VAX-11/780, it takes 14 or 15 hours.

To make a change to the circuit is a fairly big undertaking. The simulator data may have to be altered several times in order to ensure the correct functioning of the design change. Each iteration may take an overnight computer run. (Back to the days

of batch processing!) So a simple change to fix an engineering snag on a product will take a week or two to check out on the simulator.

Performance demand

The demand is there, right now, for another surge in Unix performance. DEC has produced the VAX-11/785, which will help out to a small extent, as will the 9000 series from Gould, Inc. To solve the problem of the circuit simulator, however, performance must be increased by a factor of 20 to 40 times that of a VAX-11/780.

The only way this kind of power can be provided in an economical way is to make the operating system available on the largest mainframe computers. Amdahl Corp. has marketed Unix-based subsystems under VM/370 since 1981. The company has now implemented Unix as a native operating system for the 580 series processor and UT5. As it is called, is currently running at several customer sites as part of an early installation program. On a Model 5860, a Unix application runs 20 times faster than it does on a VAX-11/780.

Development is currently under way to run UT5 on a Model 5870, a dual-processor machine that operates at 22 million instructions per second. Typically, dual processors perform at about 1.8 times the power of the corresponding uniprocessor. So the requirement for a Unix processor 30 to 40 times the power of a VAX-11/780 can be met in the short term.

Unix communications

Among the technical problems Amdahl has had to face in moving Unix to the 570 architecture machines, none has been more important than providing satisfactory support for full-duplex Asci terminals. Few self-respecting Unix programmers like the IBM 3270-style block mode, half-duplex terminals which dominate the mainframe world.

With a 3270-type terminal, when the user depresses a key, the appropriate character is displayed on the screen. Unix uses one of a number of (manufacturer-defined) special keys has been hit, the keystroke is accumulated in a buffer. When one of the special keys is hit, for example, "enter," the contents of the buffer are sent to the applications program.

With a full-duplex terminal, each keystroke is transmitted to the application program as it is entered. The application can determine which action to take. Normally, the appropriate character is transmitted back to the screen on the terminal. But that need not be the case. The application may dynamically give special significance to any key. For

PDP-11
+AIS/3210
UNIX POWER!

The AIS 3210 gives your PDP-11 the performance of a VAX-11/780 with UNIX. At a fraction of the cost.



instance, when an "A" is keyed, the application could display a "1"; or when an "" is typed, the screen might be cleared. This real-time relationship between the keyboard, application and screen provides the power of text editors such as "vi", beloved of the Unix community.

Amdahl built full-duplex Asci terminal support into UTS. Consequently, application programs such as vi and "emacs," another full-screen Asci editor, run on the mainframe Unix without modification. The full-duplex Asci support also allows us to provide "uucp," a very common Unix-to-Unix communications protocol.

In UTS, Unix has been extended to include functions to allow its use in a large data center. "Extended," incidentally, is the important word. What we have done is to port Unix System V Release 2 to the 370 architecture and then add extensions. The portability of applications that an AT&T-defined standard Unix will allow is very important to the data pro-

VM/CMS will be IBM's vehicle for competing with Unix.

cessing industry. We enthusiastically support this standardization drive.

The extensions we have made are varied. Memory management obviously required paging. System support for everything from 3270s to solid-state drums has been added. The 3270 support includes an exceptionally good full-screen editor.

Tape library management and printer spooling are other areas of vital importance in a large data center, while they matter little in a small engineering laboratory where a VAX or PDP machine may have one tape drive and a single printer. We have enhanced these areas as well.

Communications with other mainframes running MVS or VM are important when Unix is placed in the DP shop. Using channel-to-channel adapters or high-speed communications lines, jobs can be submitted from UTS to MVS or VM, and the results can be sent back to UTS.

Many of the Unix commentators like to express the opinion that IBM will determine what is going to happen to Unix. This is not a foregone conclusion.

IBM's interests are best served by promoting its proprietary operating systems, such as VM/CMS, rather than embracing another vendor's software. Promoting a system like Unix, whose strength lies in the ease with which application programs can

The VM-based Unix recently made available by IBM certainly does not lead one to believe that the corporation is vigorously pushing Unix.

be ported from one vendor's hardware to another, is not a means toward account control.

The VM-based Unix recently made available by IBM certainly does not lead one to believe that the corporation is vigorously pushing Unix. More likely, we are watching a replay of the APL story, in which a small number of enthusiasts within IBM tried, for many years, to gain corporate en-

dorsement for their product. APL did make it out the door, but only just!

VM/IX is not a generally available product; it is a Program Request for Price Quotation that will be sold only to customers with special qualifications. Furthermore, it is not based upon Unix System V, but upon the older Unix System III. And it cannot run on the largest IBM machines.

VM/CMS will be IBM's vehicle for

competing with Unix. There are, however, some reasons why Unix will win this battle.

Universities have in large part been reluctant to use VM for undergraduate computing, so graduates do not go into industry with a knowledge of how to program on it. VM has not been widely accepted on campus because of its complexity. It lacks Unix features such as pipes that allow one to create very powerful programs from simple building blocks; the absence of compiler tools such as " yacc" and "lex" makes language development difficult.

VM is also expensive on a per-user basis. Disk resources, memory and CPU requirements, as well as system programming time, all increase as packages are placed on VM to make it more productive and user friendly. In addition, large 3270 networks are

There has been a quiet revolt over the past 10 years. Programmers want user friendliness, too, and they measure it by the speed with which a system can show them the results of their work.

uncommon in university computer labs, providing yet another barrier to VM implementation. The administrative data center, which may have these facilities, is traditionally managed quite apart from the academic machines. And while the large computer center in the university typically runs the payroll, accounting, class scheduling and so on, it does not generally provide a timesharing service for the campus. As a result, micros, minis and superminis prevail.

VM/CMS is not going to disappear overnight. Many of its features may be offered under MVS in the future. We do believe, however, that it

never has answered the needs of a large portion of the data processing community who use it. These people use it because there has been no serious alternative. But there is one now — Unix.

With more than 15 years of development behind it, plus the efforts of some of the brightest people in computing, Unix has come of age. The Unix system has grown to meet the needs of its users — computer scientists, engineers and especially programmers. What are the reasons for the groundswell demand for large systems Unix?

I. The number of Unix users graduating from universi-

The Paradyne career is specially designed to offer self-motivated engineers the creative freedom and technical challenge you need to implement your most innovative concepts. You'll be interfacing with multidisciplinary teams on diverse projects...utilizing leading edge technologies like UNIX operating systems and microprocessor controls.

SOFTWARE DEVELOPMENT WITH UNIX®/C™ IN FLORIDA.

Right now, we're looking for people with the following disciplines:

SOFTWARE ENGINEERS: We are seeking Designers with experience in UNIX® operating systems combined with use of "C". Background in device drivers, communication protocols and knowledge of PC-DOS, MS-DOS and 8086 Assembly desirable.

HARDWARE ENGINEERS: Experience in microprocessor hardware and peripheral design, including static and dynamic memories, CRT & graphic terminals, DMA and interrupt controllers is required. Background in Z-8000, 8086, 8088, 80186, 80286, 80386 and 80486 processors a definite plus.

PACKET SOFTWARE ENGINEERS: We require experienced software developers and support for Zilog Z80 microprocessors or equivalent. Fluency in French language is a must as candidate will be temporarily assigned to Paris, France for 6-12 months for intensive procedure training in the development and maintenance of packet-switched network software.

PROTOCOL SOFTWARE ENGINEERS: This position requires a background in protocol and terminal emulation. Experience in C required. Experience with Intel microprocessors, "C" language, IBM 3270 or Sperry Uniscope is required. Candidate will design and develop protocol conversion and terminal emulation system for use in packet-switched networks.

NETWORK INSTRUCTOR: This individual must have training experience in Data Communications Systems...multi-plexing and packet-switching in order to deliver high and mid-level training to end-user and operations personnel. The job also includes operation of the PDS 5200 Packet-Switching Network. Some course design and development will be required including C and multi media programming.

All positions require appropriate degrees and at least 2-5 years related experience.

Our compensation package includes relocation assistance to the emerging hi-tech mecca of Tampa/St. Petersburg on Florida's Gulf Coast.

If a Paradyne career suits your professional goals, call or write: PARADYNE PROFESSIONAL RECRUITMENT: 813-230-2252. Or send your resume to: Paradyne Corporation, Professional Recruitment, 8550 Wilmerton Road, Largo, Florida 33540. An equal opportunity employer, my.

"PARADYNE" is a trademark of AT&T Bell Laboratories.

ties throughout the world over the past several years generated a large and growing pool of C programming talent.

2. The growth of Unix as a base for developing software in the defense and communications industries virtually mandated delivery systems commensurate with the size of these applications.

3. The portability of applications, which follows from implementation of Unix on everything from a personal computer to the 6570, makes it easy for cottage developers to write code that can later handle massive amounts of data when run on a mainframe.

4. User friendliness is a concept we normally apply to applications systems used by the non-DOE professional — the airline reservations agent, the bank teller, the insurance agent. Computer professionals are accustomed to fend for themselves. Their ability to wrestle with complexity is taken for granted. There has been a quiet revolt over the past 10 years, however. Programmers want user friendliness, too, and they measure it by the speed with which a system can show them the results of

their work.

There are three components required in any system that wants to respond to this revolution.

A high-level language is required, but not so "high level" that the programmer is unable to manipulate the hardware with which he is working. The C language, an integral part of Unix, answers this need. It is more powerful than assembler yet able to manipulate hardware devices directly.

On the right high-level language is available, it must be possible to use it easily. That is to say, it should not be necessary to know a great deal about the system before you can compile your first program.

The final desired component in such a system is the ability to manage source code easily in large development efforts. Unix subsystems,

such as Source Code Control System and the Documenter's Workbench, provide an integrated software engineering environment.

It has been a long time since a subject has caused as much concern over the data processing world as Unix. This operating system is not, however, a fad. Portability, flexibility and a strong bias toward programmers will guarantee its future.

Now that a good implementation is available on 370-architecture systems, its future is unbounded.

Donal O'Shea is director of UTS Products at Andahl, Inc., in Sunnyvale, Calif. He currently has business and development responsibility for Andahl's Unix-based products.

TYPGRAPHY/GRAFICS

The Job: We need a talented, creative person to be the architect of a powerful document production and graphic art system, starting with our software and hardware and limited only by your imagination. Existing hardware includes a color ink-jet printer, Data Camera system, 300 dpi laser printer, & eight interactive color graphics systems connected to four Vax 780's running 4.2bsd.

Qualifications: Must have experience developing software under the Unix operating system and enjoy producing high-quality typography and graphic art. Prefer experience with TEx and/or troff. Should have MS-C3 or equivalent experience.

About Us: The Microelectronics Center of North Carolina (MCNC) is a non-profit, non-government high-tech community center. We are located in the burgeoning high-tech community of the Research Triangle Park near Raleigh, Durham and Chapel Hill. The resources of the Center are focused on development of submicron manufacturing technology and related CAD software.

For more information contact:

Sandy Rothrock — Human Resource Manager
Microelectronics Center of NC
P.O. Box 12899
Research Triangle Park, NC 27709
(monolith or roth.mcnc@mcnc-relay)

MCNC is an Equal Opportunity/Affirmative Action Employer.

MIPS SOFTWARE PROVIDES

THE APL - UNIX® SOLUTION:

DYALOG APL

UNIX® based - fully functional commercial APL including nested arrays, upper and lower case data support for the UNIX® environment, dynamic workspace size, external functions (callable subroutines written in other languages) full screen editor, error trapping, commercial formatter and a host of other desirable features.

DYALOG APL is available for a variety of UNIX® computing environments including VAX®, PE, Gould, 3-B Series, NCR Tower, Zilog, Fortune, Penn, Ridge, Pyramid, Sun, and Convex Technologies Minimain and Megaframe. For further information about DYALOG APL on your 68000, 16032 or 8086 basic system, call or write today.

MIPS SOFTWARE DEVELOPMENT, INC.
3155 West 14 Mile Road
Suite 104
Farmington Hills, MI 48388
313-853-3552

UNIX® is a trademark of Bell Laboratories.
VAX® is a trademark of Digital Equipment Corporation.

neon row _op a leio



THE UNION OF C AND UNIX

By P.J. Plauger

The C language grew up with Unix.

When Dennis Ritchie decided to improve on the interpreted language B, a descendant of BCPL, he knew he wanted a compiled language for performance and a typed language for simple pointer arithmetic. And he knew he wanted to work under Unix because you could get more work done.

Thus was born the language of C in the early 1970s, at a time when Unix was ripe for recasting in a higher level language. And every time C failed to satisfy Ken Thompson's stringent expectations, Ritchie was there to tweak and trim his new invention to be a better sys-

tem implementation language. By the time a significant portion of Unix was rewritten in C, that first PDP-11 compiler was impressing a lot of dyed-in-the-wool assembler programmers (including this author).

The next thing you knew, people were talking about moving the Unix operating system to completely different computer architectures. What a challenge! The Interdata, Inc. 7/32, the Interdata 8/32 and the Digital Equipment Corp. VAX-11/780 were tackled almost in parallel and with remarkable success. Ritchie quickly heard about all the places where C got in the way and made the necessary changes.

C was not only powerful and clean, it was also portable. And so, too, was Unix.

This is the C of *Kernighan and Ritchie's best-selling book, The Programming Language C*. This is the C that has been moved to many machines and to numerous Unix environments by me, such as my own, Whitesmiths.

This is also the C that paved the way for the widespread migration of Unix, because the vast majority of Unix code is written in portable C. Most of the rest is written in machine-dependent C for ease of maintenance. Only the irreducible minimum of any Unix implementation is written in assembler, ignoring a few



UNIX® operating systems. An ideal has been

If you've been waiting for an ideal operating system, your wait is over. Now there's HP-UX. It is Hewlett-Packard's enhanced version of the industry-standard UNIX operating systems. And it's available right now on a wide range of HP computer systems.

Yes. It's running on our MC68000-based machines

and our powerful 32-bit systems, so you can pick the right computer for the job.

There are extra features such as graphics and networking. Plus there's a growing array of applications software available for you to take advantage of.

And the HP-UX operating system is backed by our full service organization. As with each of our high-powered systems, we're ready to answer questions.



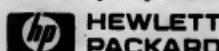
realized.

Working with both end-users and OEMs, we'll find the best solution for any particular application.

Sound interesting? Call your local HP sales office right now about the HP-UX operating system. Or write to Hewlett-Packard, Attn: Pat Welch, Dept. 003194, 19447 Pruneridge Ave., Cupertino, CA 95014. In Eu-

rope, contact Henk van Lammeren, Hewlett-Packard, Nederland B.V., Dept. 003201, P.O. Box 529, 1180 AM Amstelveen, The Netherlands.

Productivity. Not promises.



heavily used functions that measurably affect overall performance.

The influence of C on Unix has not always been positive. As a language, C stands out as being particularly terse, almost parsimonious in expression. It also performs very few checks, so that innocent-looking expressions can have disastrous effects. Hence, in C a simple statement in C can possess stupefying power.

All of these statements

have been leveled as criticisms of Unix.

It's not that the file removal utility in Unix, for instance, has to be any more dangerous than the one under, say, IBM's PC-DOS. It's an easy matter to alter the source code of Unix "rm" to be just as picky as DOS "erase." But to the original author and all subsequent maintainers, deadly power is a thing to be prized, not kept in check.

And why is it called "rm"

instead of "remove" or "erase"? That C-style terseness again. It is the work of but a moment to rename the command or simply add a longer alias, but few Unix shops do so.

You don't have to be a C programmer to use Unix, but it sure helps to think like one.

Another pernicious influence of C on Unix was just as seductive to in passing. It's terribly easy to modify the code. For ease of maintenance and

enhancement, this ability is a godsend. But in a world where literally scores of enterprises have standard environments using Unix, each in a different direction, it's a standardization nightmare.

Look at all the versions of Unix currently available: Version 6, Version 7, Programmers Workbench (PWB), 32V, System III and System V — all from AT&T alone! Then there are the repackagings of Unix: Xenix, Venix, Trux, Uniplus, to

name just a few. And then the rewrites: Idris, Unos, Coherent and so on. These efforts are understandable, after considering the diversity of sources, but they also differ in many surprising ways.

Few systems make it so easy to modify basic utilities or to rename them, or even to change the very language used to run commands. How does a software vendor hope to package an application if the options for the utilities needed to build it vary among customer systems?

The underlying reason for this unwarranted diversity is

EMERALD ONE™

**SOFTWARE WITH
COURAGE,
BRAINS AND HEART**

WHAT IS EMERALD ONE?

The most

SOFTWARE FOR THE WORK GROUP

EMERALD ONE goes far beyond stand-alone personal computer software by linking individuals and their work groups. With EMERALD ONE, users work as a communicating group, not as isolated individuals. Whether it be a document, spreadsheet or personal diary entry, everything created with EMERALD ONE can be exchanged easily between individuals, work groups and beyond.

the fact that so much basic code is written in C. First, the code itself is malleable; second, the love of malleability permeates everything else.

For years, industry observers have reported a lack of widespread packaged software for Unix. Why? The software just wasn't there. Here is the reason why: The Unix community is so ghettoized by dialects that no one packaging has a potential marketplace of more than a few thousand systems.

Thus, a handful of C programmers can give you your own private Unix, but it will probably be too private.

If AT&T can get everyone to adopt standard packagings of System V, then this situation may change. Or if IBM convinces the world that one of its (three) dialects of Unix is standard, that may change. Otherwise, the best hope is that the standards developed by /usr/group, the commercial Unix users' group, will be voluntarily adopted and prevail.

If all of these roads lead dead ends, it should also be viewed from another perspective. The criticism that C is a dangerous programming language assumes the existence of a safe one. And Unix has been criticized as not user-friendly, which implies that some system, somewhere, is user friendly.

If C is not safe, it is at least powerful; and if Unix is not friendly, it is at least cordial. No other language or operating system of comparable power does better.



P.J. Plauger is president of Whitesmiths, Ltd. in Concord, Mass., whose principal products include a broad line of C and Pascal compilers. Whitesmiths also sells the Idris operating system.

CAN THE HOLES BE PLUGGED?

T



(although in some Unix systems a user may be in several groups at once).

The file system contains data files, directories and devices (including a pseudo-file that permits access to kernel memory), which are organized into a tree of arbitrary depth. The access control mechanism allows specification of access permissions to the owner of each file, a particular group and all other users. The access permissions are "read," "write," and "execute" for all data files and devices; "status," "search" and "modify" for directories.

The granularity of control that this mechanism provides is often insufficient in practice. For example, it is not possible to grant a maintenance group write permission to a directory while preventing a member of another group read access permission to the same directory. Access to any file requires search access to all superior directories (between the file and the root node). This feature is a positive one in terms of security but has negative consequences because only one group may be associated with a directory.

It is not useful to have layered directories associated with different groups because these directories cannot be traversed without "all" permissions on all but the last directory. This makes it impossible to have layered access privileges; only vertical access distinctions are possible.

As a consequence of these weaknesses, many files and directories are configured to permit read access to most files by all users. In addition,

Current Unix security is weak, but the system's usefulness warrants the extensions necessary for sensitive commercial applications.

many users are given super-user privileges which permit them to bypass the protection of any file. These practices encourage browsing and permit disclosure of sensitive data.

These weaknesses may be overcome by the use of access control lists associated with each directory or file. The Multics operating system developed at MIT provides an excellent example of this mechanism. An access control list designates access permission by logical combinations of multiple users and groups. A reasonable, upward-compatible access control list mechanism could be incorporated into Unix.

In order to login to a Unix system, a user must present a valid user name and password. The words used for user authentication are encrypted, and the encrypted text is stored in a file accessible to all users. These public, encrypted passwords are subject to attacks by brute-force searches for strings that, when encrypted, match an encrypted password.

Even though this kind of attack cannot reasonably be used to explore all possible passwords, user selection of common words and names for

passwords makes the task tractable. The brute-force attack can be easily defeated by protecting the password file and by requiring users to select passwords that are not trivial.

Current formal (mathematical) security verification methods require that a system's security policy be implemented in a single entity of code. Were Unix secure, the kernel would contain that body of code. Unfortunately, there are two mechanisms to bypass the kernel in its role as mediator of security policy: the privileged (super-user) process and direct access to kernel memory.

Early Unix design was constrained by the need to write a very small kernel. One technique used was the separation of system status information to user-level processes. This was straightforward. Unix provides few status-gathering primitives, but instead, permits system status utilities to read kernel memory directly. Malignant users can use this capability to acquire passwords by reading kernel terminal I/O buffers. They can also determine the contents of files by reading selected kernel disk buffers.

Another kernel reduction technique was to minimize the security features implemented in the kernel and permit processes running with the super-user privilege to be unconstrained by any Unix security mechanism. These processes can also execute privileged system calls. There is a large quantity of privileged user process code that may contain bugs or Trojan horses that could be discovered and exploited by knowledgeable users.

Given these weaknesses and the large number of specific flaws that have already been identified, it is extremely hazardous to permit outside users (especially via dial-in) to have access to a Unix system.

Many of the weaknesses can be nullified by implementing restricted process environments. Access beyond a small portion of the file space enclosed by a restricted process environment would be prohibited, and no privileged processes could operate within it. Such a partitioning may be performed without modifying the Unix user interface and would make browsing outside of the partition impossible.

A secure system must have a distinct separation of roles among operators, site administrators and security administrators. A security administrator must be capable of setting a security policy that cannot be violated by a site administrator or operator. Unix has no distinct concept of operator, site administrator or security administrator. Operators are simply those users with membership in the group (or holders of the user ID) associated with system administration files. In practice, for an operator to be effective, he must possess the super-user password. This all-or-nothing approach, with its corresponding lack of accountability, makes a system operations staff especially capable of abuse.

An important feature of any system is that regular users should not be able to restrict other users from having access to system resources, including CPU space, CPU cycles and processes. On most Unix systems, a user may allocate free disk blocks on any file system to which he has access. This provision effectively prevents all other users from using that resource. Unix systems have only recently begun to provide mechanisms to limit resource allocation by users, and thus, to protect other users from the threat of denial of service.

Another security feature of importance is the ability to obtain and store an audit trail of system activity. Unix is not implemented to provide reliable auditing for two reasons. First, auditing requires a small set of points at which all system activities of interest can be captured. Unfortunately, Unix does not satisfy this requirement. Access may be made through a variety of untrackable mechanisms. Second, audit files on Unix are vulnerable to tampering. An effective audit trail must be kept and stored on a separate system (for example, a terminal access machine), which cannot be accessed by the Unix user.

Military security requirements far exceed commercial requirements.

These requirements specify that data be given a sensitivity label (for example, unclassified, secret, top secret) and, in essence, that users must have a clearance level at least as high as any data they attempt to read. A secure system must also guarantee that malicious users in different levels of security communication (the use of covert channels, including the modification of shared variables (for example, access control settings) and the modulation of shared resources (such as communications lines), must be controlled.

Bringing Unix into compliance with these requirements has proved extremely difficult. It requires the development of a formal security model, a design that can be formally verified to satisfy that model and an implementation that can conform to the design. This process means a complete reimplementation of Unix, with all of the associated risks, costs and stabilization effort. It has so far been very difficult to construct a kernel with an isolated security mechanism that also provides adequate performance.

In spite of the fact that current Unix security is weak, the usefulness of the system warrants the extensive research for more effective commercial applications. The rapid rise of remote and distributed computing exposes systems to a very large number and variety of threats. Without security improvements, Unix will be restricted to small, non-distributed environments or those in which no sensitive data is present. A major reimplementation that satisfies military requirements, while difficult and costly, will allow significant new military and commercial applications for secure systems.

Software Engineers

Tektronix and Oregon A Winning Combination

- ✓ Outstanding Careers
- ✓ Affordable Housing
- ✓ Clean Air

We have it all. Join us. TEKTRONIX is listed among the 100 best companies to work for in America and we have some outstanding career opportunities available for Software Engineers.

Our experienced Software Engineers are involved in generating new computer imaging technologies and making technology to "UNIX" kernel, device drivers, commands, utilities, and network programs. Our primary focus is on the 4.2 BSD enhancements.

The individuals we're seeking must possess leadership potential in a UNIX™ environment, be highly skilled as a C programmer, have in-depth knowledge of UNIX™ internals, VAX and PDP-11 architectures, along with related peripherals. An advanced degree is preferable, but the equivalent in related experience is acceptable.

TEKTRONIX is a Fortune 500 company that provides its professionals with competitive salaries, generous benefits that include profit sharing, health and dental insurance, and liberal educational assistance. Oregon offers natural unspoiled beauty, affordable housing, and unsurpassed outdoor recreation. For immediate consideration, please send your resume to Michele Goza, M.S. 46-943, Tektronix, Inc., P.O. Box 500, AMV1, Beaverton, OR 97077.

We are an equal opportunity employer m/f/h

UNIX is a TM of Bell Laboratories

Tektronix
COMMITTED TO EXCELLENCE

Glen Kowack manages the Unix and Environments Group at Gould Software Division in Urbana, IL.

Dave Healy is a senior member of the technical staff at the Gould Software Division, with appointments in research and development groups.

~~XENIX~~
~~BSD 4.2~~
~~ULTRIX~~
~~EUNICE~~
~~SYSTEM V~~

UNIX:
**THE SEARCH FOR
A STANDARD**

By Robert Marsh

One of the major controversies surrounding the growing popularity of Unix is the proliferation of different versions. How can Unix be a standard operating system when there is not even a single, standard version?

In June, a milestone in Unix standardization was reached with the adoption of the first vendor-independent standard for Unix-based and Unix-like operating systems. The new standard holds the promise of greatly increased compatibility among the various versions and should diminish, if not eliminate, the controversy over compatibility.

Work on the new standard began in the summer of 1981. An independent association of Unix users, /usr/group, established a working committee to define a vendor-independent standard. Representatives from major Unix-based hardware and software vendors were included on the standards committee to

ensure a range of views and interests would be represented. AT&T actively participated through representatives from Bell Laboratories, where Unix's development within AT&T continues today.

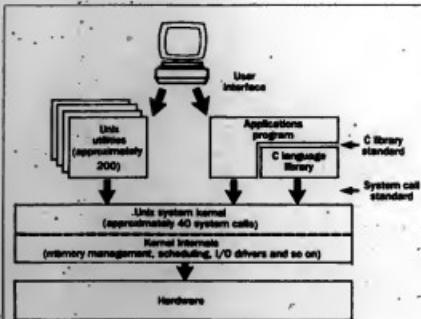
The need for a standard became more acute as Unix emerged as the operating system of choice for 16- and 32-bit supermicrocomputers. Digital Research, Inc.'s CP/M and Microsoft Corp.'s MS-DOS achieved standardization on 8-bit and 16-bit personal computers, respectively, through the efforts of their vendors, who rigidly controlled changes and enhancements to the software. In contrast, AT&T played the role of technology licenser rather than software supplier and introduced incompatibilities among its own versions of Unix. AT&T also plays the dual role of software supplier and hardware vendor in the Unix market.

A vendor-independent standard

thus becomes the only way to eliminate the inherent conflict of interest that lies behind any AT&T efforts to establish its particular Unix version as a standard.

The objective of the new standard is to establish an operating system specification that is vendor-independent yet functionally compatible with Unix. Operating systems that comply with the standard, whether derived from Unix or developed independently, offer a very high degree of applications portability.

This portability benefits every participant in the Unix marketplace. For hardware vendors, the standard is a fixed target for compatibility, eliminating the need to choose one version over another. For software developers, the standard is a framework for building portable applications packages. For end users, the standard encourages wide availability of off-the-shelf



Application portability is largely achieved by standardizing the Unix system calls and the C language libraries.

UNIX® JOBS

800-231-5920

Call us for information on the UNIX job market in your preferred geographic location. We provide a national job and applicant registry in the UNIX field. We have jobs for systems developers and software engineers, system administrators, sales and technical support engineers, technicians, engineers/managers, and virtually all other UNIX related areas. Clients range from large companies to start-ups with equity. All geographic locations are covered. Fees are paid by the employer. Send resume or call Julie Rich and ask for our free Resume Workbook & Career Planner.



Scientific Placement, Inc.
P.O. Box 1844 Dept. UU, Houston, TX 77227,
(713) 495-5100
www.sciencelink.com

CCA EMACS. THE MOST POWERFUL SCREEN EDITOR FOR UNIX AND VAX/VMS.

No other text editor gives you so much power, speed, and functionality as CCA EMACS. Or makes editing so easy. Close to 400 built-in commands let you do any task with only a few keystrokes. Even things that are impossible on other editors. And with our C command language and extension language, Elisp™, you can customize CCA EMACS to meet your program requirements.

Multiple windows are another important plus. So you can manage concurrent processes and move information from one



To get a trial copy, call Greenwich Whistler at (617) 492-8860.

window to another. And CCA EMACS is supported by a full online documentation package that includes a user's manual, tutorial, and so on. So any user can quickly utilize all the power of CCA EMACS.

CCA EMACS runs on Berkeley Unix® (4.1BSD and 4.2BSD), Bell Unix (System III and System V), and VAX/VMS™.

Prices for a binary license range from \$350 to \$1900.

For more information, or to find out how

CCA Uniworks, Inc.
■ A Cewecon Company
Four Cambridge Center, Cambridge, MA 02142

A major contribution of the /usr/group effort is agreement on a standard method for file locking.

Unix-based software that executes without change on hardware from various system manufacturers.

A primary problem in creating a standard is deciding exactly what to standardize. Unix is a large, complex operating system compared with the previous CP/M and MS-DOS standards.

A typical Unix implementation includes more than 200 commands and utilities and as much as 8M to 10M bytes of object code. However, the goal of application portability is largely achieved by standardizing two relatively small parts of the operating system, the Unix system calls and the C language libraries. The diagram shows how these two interfaces relate to the Unix system as a whole and to user application programs.

Two critical interfaces

The system calls are the fundamental interface between the application program and the kernel. The application programmer uses these calls to perform file and terminal input and output, to manage files and directories, to launch other programs, and so on. The 29 system calls defined in the standard give Unix a very "clean" interface between the application program and the operating system. Popular MS-DOS applications (such as Lotus Development Corp.'s 1-2-3 and Micropro International Corp.'s Wordstar) often directly access internal operating system routines, creating a dependence on the internal structure of the operating system.

User applications interact with the kernel only through the system calls and are isolated from the internal structure. For example, different kernels may support virtual memory,

real memory or swapping schemes for memory management yet still retain absolute compatibility with the system call standard.

This feature greatly increases the portability of Unix, since a hardware manufacturer is free to adapt the Unix interfaces to suit particular hardware.

The other Unix interface addressed in the new standard is the standard C language library. The library is a collection of utility routines frequently used by commercial application programmers. These routines include functions for mathematics, table sorting and searching, string manipulation, I/O formatting and encryption, among others. With these functions in the standard, application programmers are assured that programs that rely upon the library will run and will execute properly regardless of the operating system that conforms to the standard.

The standard does not include a definition of a Unix user interface, nor does it yet deal with utilities and commands. These interfaces vary much more widely among versions than the system calls and libraries and pose a more difficult standardization effort. More important, they tend to be application-dependent and are therefore poorer candidates for standardization.

An excellent example is the command interpreter, or shell. While the AT&T Bourne shell is the most widely used user interface today, software developers often favor the alternative C shell, developed at the University of California at Berkeley. In turnkey installations, the shell is often replaced altogether by an application-specific, menu-driven program. This flexibility and adaptability is one of Unix's great strengths, and efforts to standardize on a single command set or user interface that will suit all potential applications probably aimed in the wrong direction.

Basis for standard

Although the /usr/group standard is independent of any particular version or hardware implementation, its contents are based heavily on Unix System III from AT&T. Indeed, an operating system can be in full compliance with the standard and not contain a single line of "Unix" code from AT&T. Several such Unix look-alikes have already been developed.

The standard preserves the key characteristics that have made Unix popular, including:

- Multiprogramming: Multiple, concurrently executing processes are supported.

- Multitasking: Individual users of the system are uniquely identified and optionally organized into "user groups."

- Security: Access to files is controlled on the basis of the user/user group organization.

- Hierarchical file system: A hierarchical directory structure is used to organize files.

USER GROUPS

NATIONAL

/usr/group
Suite 200
4655 Old Ironsides Drive
Santa Clara, Calif. 95064
2,000 members; \$100 general membership; \$60 associate membership; publishes "Communix," a bimonthly newsletter.

Ussenix
P.O. Box 7
El Cerrito, Calif. 94530
1,200 members; individual membership \$30, student \$15; institutional membership \$260; educational \$100; supporting member \$1,000; publishes bimonthly newsletter "login."

REGIONAL

New England Unix Users' Group
Consumer Financial Institute
288 Walnut St.
Newton, Mass. 02116
250 members; free.

Unigroup
P.O. Box 1931
New York, N.Y. 10116
325 members; \$35.

Unix Houston
P.O. Box 441748
Houston, Texas 77244
50 members; \$24 for individual or one-person corporation membership.

INTERNATIONAL

Nippon Unix User-Kai
Joint System Development Co.
(Kyodo System Kaihatsu Ltd.)
Yusei-Gojekai-Kotobira Bldg. 14-1
Toranomon 1-Chome
Minato-ku, Tokyo 106, Japan
Contact: Kiyoshi Narita

Association Francaise des Utilisateurs d'Unix
152 bis, Avenue Max Dormoy
92120 Montrouge
France
Contact: Jean Louis Bernard
100 members.

European Unix User Group
Helen Gibbons, Secretary
Owles Hall
Buntingford
Herts SG9 9PL
Royston, England

Australian Unix User Group
Dept. of Electrical Engineering
University of New South Wales
Kensington, New South Wales
2033

Australia
Contact: Kevin Hill
500 members.

National Unix Systems Users
Group Netherlands
Martin van Gelderen, Secretary
Nikhef Sector K
Kruislaan 411
1090 SJ Amsterdam
The Netherlands

■ Pipes: The famous Unix method for process-to-process communication is now provided.

The differences between the standard and the various Unix versions in popular use arise mostly from hardware dependencies or inconsistencies among the versions. System calls to facilitate user accounting, for example, are present in several of the popular versions (System III, System V, Berkeley) but are not included in the standard. Similarly, the details of terminal I/O control are left unspecified in the standard, although the system call to perform this function is included. Variations among the versions in the control of character echo, half- and full-duplex operation and similar low-level terminal functions made standardization at the detail level impossible.

A major contribution of the /usr/

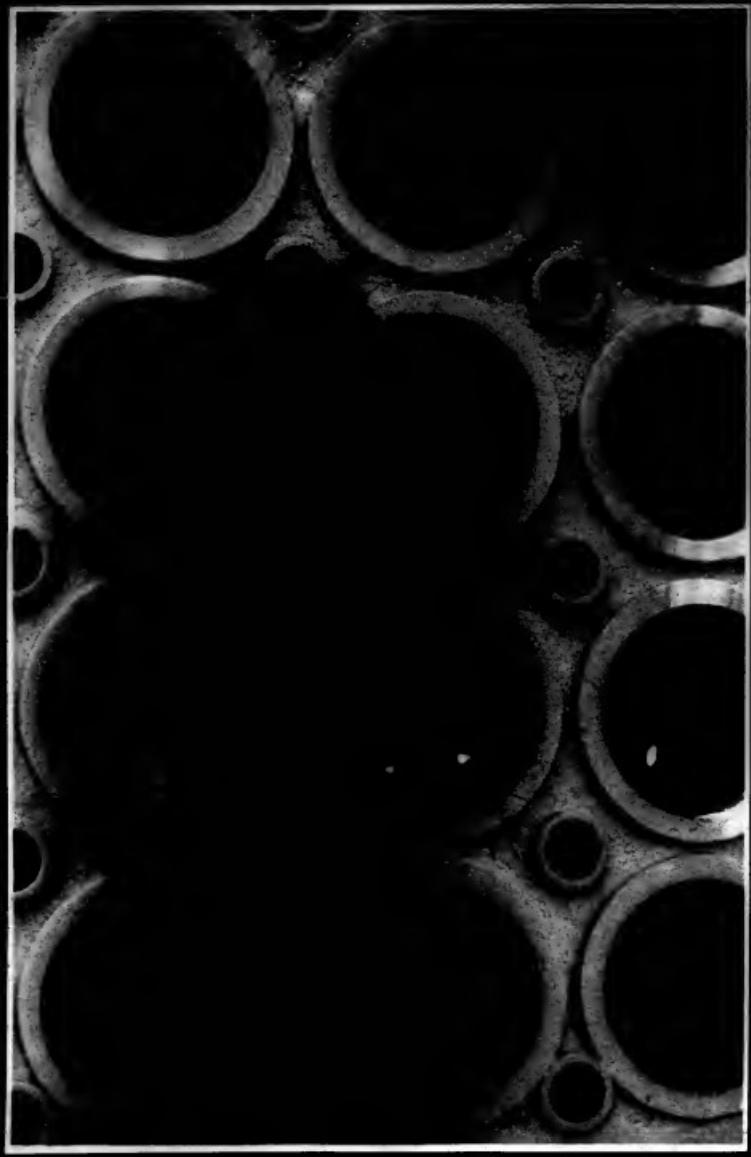
group effort is agreement on a standard method for file locking. The standard specifies a system call for record-level locking of shared files to coordinate concurrent access by several users. While this feature is critically needed in commercial multuser applications, it has not yet appeared in an official AT&T Unix version. Almost all commercial Unix system suppliers have added record locking to their implementations, however, and the standard gives this "standard Unix extension" more official status.

The standard is also highly compatible with Unix System V, which has been the focus of heavy advertising and promotional support with AT&T's entry into the computer business. The only major feature of System V not addressed in the standard is its shared memory and interprocess communications facility. These capabilities, while important technical extensions to Unix, arrived with System V. They have not yet found wide acceptance among Unix-based software developers but are probably excellent candidates for future addition to the standard.

Copies of the official /usr/group standard and information about membership in /usr/group can be obtained by writing to /usr/group, Suite 200, 4655 Old Ironsides Drive, Santa Clara, Calif. 95064.

Robert Marsh is chairman of the board, Pleux Computers, Inc., in Santa Clara, Calif. He was one of the founders of /usr/group and its first president. He currently serves as a director.





YATES

UNIX

The story of Unix is one of several software organizations working separately to take an operating system from its beginnings in a Bell Labs research environment to its present status as the premiere portable and user operating system. Although the resulting phenomenon is thought of as Unix, it goes by other names as well: 4.1 BSD, Xenix, Zenix, Regulus, Unos, PC IX, Unix, and many more.

Since the initial release, universities have enhanced Unix. The most prominent example is the University of California at Berkeley. With research funding from the Defense Department's Advanced Research Projects Agency, Berkeley added virtual memory, the Lisp and Pascal programming languages, a data base management system and networking support to Unix. In addition, an enhanced user interface known as the "C shell" or "csh" made Unix more friendly to programmers, who could take advantage of the shell's features such as command history, which allows users to recreate their actions from any point.

As a result of Berkeley's enhancements, its versions of Unix (which go by a release number followed by "BSD" for Berkeley Software Distribution) became extremely popular in high-tech firms, especially defense shops. Since high-tech firms and universities made up the largest portion of Unix's early customer base, the BSD releases are still the most prevalent Unix versions on mini computers, the machines typically used in such environments.

Unix will be used by the majority of office workers and small businesses by 1989.

At the same time, software houses were making commercial enhancements to bring Unix to the office. Microsoft Corp. is the most prominent, but Unisoft Systems Corp.'s Uniplus is the most widely used, and Interactive Systems Corp. was the first to make available a commercial version of Unix. In addition, a number of companies are offering operating systems that look like Unix to the user but are not based on Bell Labs' source code.

Microsoft's Xenix is the best known derivative. The company included features to lessen the need for sophisticated system administrators, thus allowing Unix to be commercially acceptable for the microcomputers that were finding their way to the office. In addition, Xenix was ported to the most popular microprocessors, making a single version of Unix available across all of them. Finally, the inclusion of support made Xenix much more attractive to the nontechnical commercial world than Unix had been. With IBM's announcement of Xenix on the Personal Computer AT, its success as the micro Unix standard is assured.

Unisoft specialized in porting Unix to Microdata's 32-bit RISC-based microcomputers. Unisoft has been the most popular vendor of Unix on microcomputers, and runs on more than 100 different machines.

Interactive Systems Corp., a software house to start, has also ported enhanced Unix by adding a free automation package to its version of Unix. IS was originally available only for Digital Equipment Corp. minicomputers, but Interactive Systems has recently chosen as the supplier of Unix (known as PC-UX) for the IBM Personal Computer.

While Microsoft, Unisoft and Interactive Systems all started with source code supplied by Bell Labs, other firms took different routes to developing operating systems that looked like Unix. These are known as Whitesmiths, Idris (the developer of Idris), the Mark V, Harris Co. (Coherent) and Cray River Data Systems (Cmos).

Because inexpensive Unix binary licenses were not available, companies like these decided to start from scratch in developing operating systems that appeared to be Unix but were not legally thus avoiding the high price tag associated with a Unix source license.

Meanwhile, the developers at Berkeley and elsewhere were not sitting still. Berkeley's 4.1 BSD release was becoming a new standard in the high-tech community, and sales were picking up for Microsoft, Unisoft and other commercial vendors. Their enhancements ranged from making Unix run faster to adding application

software and support for real-time processing.

It is still not clear what the future will bring for companies developing their own Unix versions.

AT&T is expected to add slowly the enhancements that others have made, perhaps to pull Unix closer to 3B-specific hardware designs. Over a future incarnation of System V, however, enough improvements to make it competitive in the office, there will be less room for Unix derivatives. AT&T has also been adding many of the Berkeley enhancements. With Berkeley in no position to support its own version of Unix, even die-hard BSD fans may slowly come over to System V and its descendants.

The other versions of Unix will be around, at least for a while, but it appears that their moment in the spotlight is coming to a close.

THE YEAR OF SOFTWARE

The lack of application software for Unix supercomputers, however, is the deficiency that could doom Unix as a commercial operating system. However, several forces will converge this year to eliminate this lack of application packages.

Today there are many custom applications for minicomputers running Unix. Perhaps more important, there are enough trained C programmers to provide the world with good application software. Missing from the equation has been a sufficiently large installed hardware base to make the writing and distribution of applica-

tions profitable.

Microsoft's Bill Gates explained: "When the Unix hardware installed base reaches 500,000 units, more software developers will deem Unix worth their application efforts." That milestone will be reached late next year.

C rewrites

In anticipation of more complex CPUs and operating systems for micros, many applications developers began rewriting their programs in C during the last two years. The portability of this language, which is emerging as the standard development language, ensures that these software companies will be ready for any operating system that might emerge as a standard — especially Unix, which is written in C.

Consequently, there are hundreds

of application programs, already written in C, which can be rushed into the Unix supermicro market as soon as the installed base expands to the point of making the effort profitable. That day is close, the catalyst being IBM's Personal Computer AT.

The AT has MDA DOS and XENIX, Microsoft's implementation of Unix System III. Software developers interested in multitasking, multilayer applications functionality see XENIX on the AT as a potentially huge installed base. Many market opportunities have been created by the new AT's high random-access memory (RAM) limit (32 MB), hard disk capacity (40 MB bytes) and more powerful 286 CPU. For the user to take advantage of these features more fully, XENIX must be used as the operating system.

AT&T has a vested interest in making it profitable for software developers to bring products to market. Recently, the AT&T Information Systems group set up several programs

When it comes to your UNIX training, ITS has a one-track mind.

the fast track.

Interactive Training Systems, Inc.

AT&T has a vested interest in making it profitable for software developers to bring products to market.

to promote this process.

AT&T established the Independent Software Vendor (ISV), Vendor Involvement Program (VIP) and Systems Library program to encourage the adoption of Unix System V as a standard. The strategy is to encourage independent software vendors to increase the quality and quantity of software on Unix-based computers. Software vendors in the programs receive a 25% discount on leasing a 3B computer, AT&T's distribution of the vendor's application (in the case of the System V Library program) and quality control consultation.

The ISV and VIP programs are similar, but run by different divisions at AT&T. The ISV program, developed at AT&T Technologies, is headed by John Evans, the software publishing manager. The emphasis here is to market products to value-added resellers. The ISV program concentrates on encouraging the production of horizontal applications, such as graphics packages and data base management systems (DBMS).

The VIP program, under the direction of AT&T Information Systems, is headed by Paul O'Brien. Since the Information Systems division is geared toward end-user products, applications adopted are for vertical markets.

The Unix Systems V Library is a joint venture of Digital Research, Inc. and AT&T. The Systems V library publishes independently written application packages and offers them for sale on a wide variety of hardware.

These programs have been good for all software vendors, but they especially help vendors who have already established themselves in the Unix market. Invariably, these companies wrote an application package for the Unix minicomputer market,



Jean Yates

specifically for Digital Equipment Corp. hardware. As this market became saturated and as Unix moved down onto supermicros, these vendors ported their products to smaller machines.

The most conspicuous success has been Relational Technology, Inc.'s Ingres DBMS package. Originally developed at Berkeley, it runs on the DEC VAX. Ingres can now be found on Unix hardware including popular models such as the Tandy Corp. Model 16, the Altos Computer Systems, Inc. 586 and the Zilog 8000. This summer, Relational Technology entered into a long-term development and marketing agreement with AT&T. Ingres was selected as the relational DBMS throughout AT&T's 3B product line, with Ingres/CS (Compact System) running on the 3B20.

Several other software packages have succeeded in the Unix market, including Multiples (spreadsheet) from Microsoft; Informix (DBMS), Relational Database Systems; Horizon (word processing), Horizon Soft-

ware; Ultra Calc (spreadsheet), Olympus Software; Unity (DBMS), Unity Corp.; Q-1 (word processing), Quadratron Corp.; and MBSI (accounting), Real-World Systems.

IBM GIVES ITS BLESSING

The sudden popularity of Unix is the result of several powerful forces affecting the industry:

- AT&T offering the 3B2, 3B6 and 3B20 products, a comprehensive line of computers running Unix as the primary operating system.

- AT&T's extensive print, conferencing, and communications equipment and its announcement of PC/IX and the market's anticipation of further IBM/Unix announcements.

- Growing demands by corporate department managers for cross-vendor networks of personal computers,

UNIX-TYPE SYSTEMS

The following systems can be purchased on end-user systems.

Unit type (licensed by Bell Labs)	Company
BSD 4.1	U.C. Berkeley
BSD 4.2	U.C. Berkeley
Astro	Amiga Corp.
CP-UX, VME-UX	IBM
Edition VII workbench	Bell
Euclid	The Wollongong Group
FOS	Fortune Systems Corp.
Genix	National Semiconductor Corp.
HP-UX	Hewlett-Packard Co.
IS/1	Interactive Systems Corp.
iOS	Orca Systems Inc.
OSX	Pyramid Technology Corp.
Perpos	Computer Consoles, Inc.
PC/UX	IBM/Interactive Systems
RTU	Mesocomp Co.
Symb	Plexus Computers, Inc.
System III	Bell
System V	Bell
VME	Bell
Unix	Tektronix, Inc.
Uniplex +	Digital Equipment Corp.
Unisys	Unisys Systems Corp.
Unity	Codata Systems Corp.
UNIX/VIS	Human Computing Resources Corp.
UTK	Data General Corp.
VME	Gould, Inc.
Version 6	Unicomm, Inc.
Version 7	Bell
Xenix	Microsoft Corp.
Zeus	Zilog, Inc.

Sales of the following Unix-type operating systems do not result in royalty payments to Bell Labs.

Unit type (not licensed by Bell Labs)	Company
Coherent	Mark Williams
Imsai	Cromemco, Inc.
Imsic	Wrightsoft, Ltd.
Osiris	Montauk Design, Inc.
OS-9	Phase One Systems, Inc.
PNX	Ginn, Inc.
QNX	Perg
Regulus	Quantum Software
Uni-Del	Alcyon Corp.
Uros	SMC
source: Yates ventures	Charles River Data Systems, Inc.

departmental minis or supermicros and mainframes, all running the same application software.

Changing strategies

These and other market forces are prompting hardware manufacturers to alter their competitive strategies in order to reap the benefits of con-

sumer demand for a standard, flexible, multiuser operating system.

Although still dwarfed in comparison with the total units shipped with Microsoft's MS-DOS (PC-DOS) and Digital Research, Inc.'s CP/M, Unix will be used by the majority of office workers and small businesses in this country by 1989. By the end of this

PROGRAMMERS/PROGRAMMER ANALYSTS WANTED

HSI develops medical and clinical information systems which monitor hospital case mix and utilization of services.

We have initiated an aggressive software product development program thru 1990. This situation presents an opportunity to direct and participate in major system development activities.

The bright, effective people we are seeking presently function as Senior Programmer Analyst, Programmer Analyst, or Programmer with 2 or more years experience.

We utilize a project team structure and our environment features UNIX and C.

Please send resume with SALARY HISTORY indicating position of interest to:

Associate Director of Personnel
Health Systems International
100 Broadway
New Haven, CT 06511
An Equal Opportunity Employer

ANNOUNCING the RCI Unix™ Tool Directory

- Hundreds of Useful Tools Described, Classified and Cross-Referenced
- Features Analysis Provided Using NBS Tool Taxonomy
- Subscription Service Including Directory, Updates and Newsletter

Only \$95* Prepaid

- informix™ Source Version is available at additional cost

for more information, a free descriptive brochure or to place your order **CALL TODAY**

(213) 373-8728



Reifer Consultants, Inc.
2550 Hawthorne Blvd., Suite 206
Torrance, CA 90505

Unix™ is a trademark of AT&T Bell Labs. informix™ is a trademark of TDS, Inc.

decade, the evolution of the workstation market, multiple operating systems and networking capabilities may undermine the importance of operating systems. However, before that happens, the Unix market will undergo growth, shakeout, plateau and then decline, which is standard for every new market situation.

Virtually every major hardware vendor in the world is now considering some sort of Unix strategy.

Until now, it has been generally assumed that the controlling force in the Unix market would be AT&T. In December, AT&T announced System V.2 in an attempt to establish a standard Unix. This effort was prompted by the confusion surrounding the 23 or so "flavors" of Unix that are presently available. Accompanying the announcement of V.2 was the promise by AT&T to make licensing easier and more attractive. Of course, importance was AT&T's commitment to actively market and support the Unix efforts of its hardware OEMs.

IBM immediately perceived the consequences of staying out of the

growing Unix market. Shortly after the AT&T announcement, IBM attempted to preempt the market by announcing PC-IX, a System III implementation for the IBM Personal Computer.

This announcement came shortly after a trial balloon announcement by the IBM Instruments Division of Xenix on the 9000. A third announcement came from IBM of Xenix on the 9002 and a marketing effort to position the 9002 as an office automation product.

On the third anniversary of the Personal Computer, IBM announced the PC/AT, thus filling the last major gap in the IBM Personal Computer product line and opening up the Unix market. We can now say that Unix has truly arrived as a standard.

System V's influence

Unix is the standard minicomputer operating system for 10-15 years now. Mainframe demand will encourage Unix implementation across micro, mini and mainframe products by all major vendors. Virtually every major hardware vendor in the world is now considering some sort of Unix strategy, either for a single product or across an entire product line.

The deregulation and subsequent reorganization of AT&T is resulting in a more aggressive effort to move System V towards becoming Unix.

The adoption of Unix as an industry standard has been hampered by the lack of one standard Unix. Xenix dominates the low end of the market with more than 50,000 installations. System III and Version 7 are common

between \$25,000 and \$100,000, and proprietary versions can be found on many mainframes.

This proliferation of Unix types will end if AT&T is successful with plans to promote System V as the standard. AT&T is working closely with Digital Research, Inc. and several major chip manufacturers to standardize the product. However, this standardization process is hampered by the fact that standard Unix must be altered to make it attractive and user friendly with little technical expertise. In order for System V to become

the true standard, AT&T must adopt a user interface that can be used across an entire product line, as well as record locking, virtual memory/paging facilities and more.

This year will see several major hardware vendors announcing a Unix product or line. Software developers, which have been rewriting applications in C, will then rush to offer software products to a growing market. The availability of these products will overcome the last obstacle to the establishment of Unix as a standard.

VAX-UNIX-SPREADSHEET Q-CALC

As powerful as Lotus 1-2-3®

All spreadsheet functions

Graphics available

Runs on all Unix® versions

call/write

Quality Software Products Inc.

348 S. CALIFORNIA DRIVE
BEVERLY HILLS, CALIFORNIA 90211
(213) 669-1566

* Lotus 1-2-3 is a trademark of Lotus Corp. Unix is a trademark of Bell Laboratories.

THE BERGER SERIES OF DP PERSONNEL TESTS

NOW INCLUDES

the Berger Aptitude for Programming Test...the Berger Computer Operator Aptitude Test...the Berger Tests of Programming Proficiency: Basics of Programming...COBOL...FORTRAN

→ **"C" PROGRAMMER PROFICIENCY TEST** ←
OS JCL...IMS Data Base General Knowledge...IMS Data Base Programming...CICS...IBM 360/370 Assembler...

→ **UNIX USERS PROFICIENCY TEST** ←
Berger Systems Analyst General Evaluation: Systems Analyst Test...Systems Development & Design...Systems Testing, Operations, & Maintenance...Systems Management.



For information contact:

PSYCHOMETRICS INC., 2800 Olympic Boulevard
Suite 1000, Los Angeles, CA 90040 (213) 629-0348

Co-Directors Frances E. Berger, Ph.D. Raymond M. Berger, Ph.D.

LANGUAGE PORTABILITY — KEY TO MARKET PROFITABILITY

W_{hile} managed companies — the ones which will continue to profit and survive the Information Age — are learning that — know the importance of wisely choosing application language. Since 1978, DRL has helped thousands of companies choose DRL to support their business language needs. DRL is an environment, tool, and methodology across microcomputers, as well as minicomputers. And with DRL, you can port your application to other DRL environments. DRL is absolutely convinced that you will improve your own chances of surviving the shakeout in the computer industry. Here are many reasons why this is true.

Let's briefly examine some of the facts.

FACT ONE: DRL'S LANGUAGE PORTABILITY DRL parts across hardware systems. Hardware portability does eight times more than you will be a part of.

FACT TWO: OPERATING SYSTEM PORTABILITY DRL also ports across operating systems. This means you can apply DRL to, for example, MS-DOS can also run under UNIX, VMS, VME, VMEbus, the Apple II, PC-DOS, UNIX Systems III and V, Version 7, and Berkeley Implementations 4.1 and 4.2, and Under VMS, VME, VMEbus, VMEbus, and RMX, and RTTS, and VMS, and TSS+, and VMEbus.

FACT THREE: SHAKESHAKE If you are using a language which is tied to one manufacturer's hardware, then your company is in trouble. If the hardware changes, so does the shakeout, then so does your company. You can avoid shakeout fallout with DRL. ports

across hardware, across operating systems, and across hardware and software packages!

FACT FOUR: ADDITIVE MARKETS. Since DRL ports to, and from, and among so many hardware and software packages, DRL users are now able to use your current market these additive markets converge. DRL, DOS, PC-DOS, UNIX Systems III and V, and Version 7, and UNIXPlus+, and VME, and VMEbus, and RTTS, and VMS, and TSS+, and more.

FACT FIVE: DRL SET OF SOURCE CODES. DRL's source code is the most complete, tightest, and easiest to learn set of source code.

FACT SIX: PRICE. The price of the PC version of DRL is less than \$1000. Best! You can prove every fact for yourself just test first. DRL's source code is the most complete, tightest, and easiest to learn set of source code.

FACT SEVEN: SURVIVAL. DRL's source code is the most complete, tightest, and easiest to learn set of source code.

FACT EIGHT: PORTABILITY. DRL'S LANGUAGE PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL'S source code is the most complete, tightest, and easiest to learn set of source code.

FACT NINE: PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

FACT TEN: PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

FACT ELEVEN: PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code.

PORTABILITY, SHAKESHAKE, ADDITIVE MARKETS, ONE SET OF SOURCE CODE, and DRL's source code is the most complete, tightest, and easiest to learn set of source code

BREAKING OUT THE MARKET

Yates Ventures has divided the Unix market into seven price points: \$1,000 to \$6,000; \$6,000 to \$12,000; \$12,000 to \$25,000; \$40,000 to \$60,000; \$60,000 to \$100,000; \$100,000 to \$350,000; and \$350,000 and above. Research shows major differences between these price points in configuration requirements, Unix type and distribution channels.

In compiling information in these categories, assumptions were made:

- Only shipment rates of systems with licensed Unix were measured.
- All prices are end-user quantity one.

- Computer prices are for minimum configuration, including operating system, terminal and one year of maintenance.

- Price is held constant as capability and capacity of configurations increase.

- Dollar projections are weighted average (by price point) of units shipped multiplied by shipment rate projections.

There are more than 80 hardware vendors offering 125 different hardware products with Unix. Both of these figures are expected to grow by 30% this year. Inevitably, the market will begin to eliminate many vendors after the explosive growth rate for Unix-based hardware begins to slow by the middle of 1985. Many companies founded in 1981-82 to provide Motorola, Inc. 68000 chip technology to an immature market, will find themselves unable to compete with major vendors such as IBM and AT&T for materials, shelf space, value-added reseller contracts and trained technical personnel. Bankruptcies, mergers and buyouts will be common in 1985.

The price/performance ratio of computer systems will decrease at a rate of about 4% during the next two years. (Customers will receive about four times the computing power for the same dollar investment.) After 1985, the curve will level off for the next several years as software developers struggle to take advantage of these changes in hardware.

Chip sales

Motorola dominates chip sales in the Unix market. In the \$6,000 to \$12,000 price point, more than 80% of the units shipped were powered by MC68000 chips. In the next two price points, Motorola's share of the market will drop, Zilog, Inc. and, to a lesser extent, Intel Corp. Above \$60,000, proprietary CPUs dominate, but Motorola is making significant inroads with new manufacturers entering the market.

By 1985, National Semiconductor Corp. (16082) and Intel (286) will become popular as 32-bit systems begin to replace 8- and 16-bit systems. Motorola will continue to do well in this market with 68010 and 68020 CPUs. Zilog is presently doing well with its Z8000, and Z80000 will be available by next year.

In under \$60,000 systems, 256K and 512K random-access memory (RAM) is very common.

Several vendors in these price points are offering systems with 128K RAM, but because of the requirements of the operating system,

these computers must be upgraded to run Unix effectively. During the next two years, even computers selling for less than \$25,000 will include 2M to 4M bytes of RAM.

Total installed units as of Jan. 1 are approximately 135,000, most of which (90,000) were shipped in 1983. Sales last year amounted to more than \$9 billion for computers, terminals, Unix and minicomputers.

Unit shipments of Unix-based hardware will rise from 90,000 in 1983 to 325,000 in 1987. By the beginning of 1988, the total installed base will top 2.5 million. The majority of these systems will be in small businesses, vertical markets and Fortune 1000 companies. Most of the larger Unix systems will also have a second operating system running over or under Unix.

Key assumptions about the market and its impact on growth rates are:

- Unlicensed Unix will dominate the \$1,000 to \$40,000 price point.
- Retail sales of Unix systems will increase.

- IBM will continue to test the Unix market with several new product offerings to be announced by end of 1984.

- Start-up companies, with few exceptions, will never ship as many units as forecast, and many will leave the market by the end of 1985.

- Software development will align Unix-to-MS-DOS communication by 1986.

- Fault-tolerant Unix will be available for process control by the fourth quarter of this year on some vendor's equipment.

- The popularity of Unix-based micros will create a demand for upward migration paths.

- Government/military sales will be an increasingly important vertical market.

SOFTWARE FOR SURVIVAL

Sales of Unix-based hardware approached \$2 billion in 1983. This figure will grow to almost \$12 billion in 1987, with strong support from the offerings of IBM, AT&T, Digital Equipment Corp., Hewlett-Packard Co. and other major vendors.

These vendors will enlarge and stabilize the Unix market and create opportunities for some of the smaller vendors.

However, the net result will be increased competition through the distribution channels, which will result in the elimination of undercapitalized

and companies from the marketplace.

Increasingly, hardware vendors will be unable to differentiate their products on the basis of hardware performance. Computers will become a commodity item, with the possible exception of products offered by IBM. This situation will force hardware vendors to find other methods of differentiating their products.

The most obvious differentiating factor will be software. Traditional Unix vendors like Altair Computer Systems, Inc. and Fortune Systems Corp. have been successful by offering their products as a multiuser solution made possible by Unix. However, their unique position in the market is quickly being usurped by new products running Unix offered by other vendors. As Unix becomes

Computer Professionals

Computer Systems Designer

Existing opportunity to develop a new, portable, distributed computing environment. Candidates must have thorough knowledge of UNIX® Kernel and its dependencies. Ref. 21075.

Manager of Academic Applications Development
Will plan and direct Stanford's introduction of microcomputer technology into the academic curriculum. Supervise professional programmers and consultants liaison with major microcomputer manufacturers. Help define and create the learning tools of the 80s. Applicant must have demonstrated experience as a project manager, programming manager, or supervisor. Ref. 40481.

Competitive salary, excellent benefits, and liberal vacation.

If interested, please send resume and salary history to: Kathy Dallmeyer, Business University Personnel Department, Stanford, CA 94305. Stanford University values diversity and welcomes applications from women, minorities and disabled individuals.

*UNIX is a trademark of AT&T Bell Labs.



Stanford
University



the standard multiuser operating system, vendors will be forced to offer application packages, especially word processing, to their customers.

Support is emerging as the second major differentiating factor. As the market shifts from technically trained programmers to relatively naive end users, support requirements change. Unfortunately, the support programs of most vendors have not

changed with the market. This situation is creating great opportunities for companies that can differentiate their products on the basis of dependability and reputable support programs.

A major trend is the emerging importance of vertical markets. By 1987, a full 60% of all Unix-based hardware will be sold into vertical markets. This is a projected \$7 billion market opportunity for hardware

The need for flexibility is one of the major reasons for the growing popularity of System V at the expense of BSD 4.1.

vendors and system integrators offering turnkey solutions to business problems.

The price of fluid integration in vertical markets is difficult

for vendors to exploit and confusing for end users trying to make purchase decisions. System integrators were born from a need by minicomputer vendors to reach a market that could not be addressed profitably through direct sales. These remarketers quickly found that they could differentiate their products through the use of vertical market software. Since the late 1970s, when most system integrator companies were founded, hundreds of small software developers have entered vertical markets with their products. Today, there are no fewer than 10,000 vertical market packages available.

This situation makes it virtually impossible for potential customers to make informed purchase decisions. The result of this confusion is that potential customers are postponing those decisions. The future for vertical markets is with export salespeople, selling turnkey solutions, with the ability and

reputation to provide dependable support.

There are two main segments which offer substantial opportunities for growth. The first is the scientific market above \$100,000. This area has traditionally been dominated by DEC and its VAX and PDP-11 families. A major reason for this dominance has been the fact that the fastest and easiest way of getting Berkeley 4.1 Unix source code was by purchasing a VAX. However, the situation has changed dramatically as AT&T has begun promoting System V as the industry standard. Not only is source code available now for a wide variety of computers, but BSD 4.1 is beginning to lose favor as the Unix version of choice at this price point.

There is a general trend at this price point to utilize computer power for general purpose. Hardware that was purchased primarily for scientific and engineering applications is now being shifted into more general business use. Data processing managers are beginning to consolidate the computing power of the company into a

central structure. Consequently, DP managers are looking for operating systems with more general applications. This need for flexibility is one of the major reasons for the growing popularity of Unix and a major reason for the growing popularity of System V at the expense of BSD 4.1.

These changes in the market are fueling a growing trend toward multiple operating systems. A notable example is the 90x computer from Pyramid Technology. The 90x comes with both BSD 4.2 and System V. The operating systems can be configured by the user at any time. This product is an attempt by Pyramid to fill the gap between the business and scientific market, without having to sacrifice either. Several other companies are also experimenting with multiple operating systems, including other switches or windows to accommodate the second operating system. The Tandy Model 16, best-seller in the Unix market, accommodates both Xenix and TRS-DOS.

The second major opportunity exists for business automation in the \$12,000 to \$25,000 price point. Currently, there are manufacturers of 40 to 50 hardware products in this market segment. Many of these manufacturers are offering products in anticipation of IBM entering and expanding this market. The Personal Computer AT's announcement legitimizes their products, and the IBM stamp of approval will expand their market.

Finally, there is clearly shown that there is a growing pent-up demand for multiuser capabilities at the \$42,000 to \$225,000 price point. Potential customers with some experience using computers have realized the advantages of multiuser, multitasking capabilities. They may already own a business or home computer and are looking for upgrade. However, these potential customers are not willing to take a chance with a product from a manufacturer they know nothing about. Consequently, they are postponing their purchase until they can buy something "safe" and dependable. IBM has answered their need with Xenix on the AT and will probably offer additional products targeted at office and lab, with Unix as a major operating system.



A Software Implementation within Your Product Hardware

If you manufacture a computer system or a computer based product, allow it to communicate with your system by installing one or more of Systems Strategies' C7 Language based communication packages.

- 2810 SNA/DEC Emulation
- 2810 BSC Emulation
- 2810/2815/HARP Emulation
- X.25 Levels 1, 2, 3 Communication

You can purchase these C7 Language packages with source code and documentation or you can purchase them as a turnkey solution with a complete system. You can also purchase them with source code and documentation and add them to your own system. We can also provide other "off the shelf" products with documentation and training or ported to your hardware by Systems Strategies' communications staff.

Systems Strategies/Advanced Technology Division
Specialists in Data Communications Software

Systems Strategies Inc.
220 North 24th Street
Newark, NJ 07105
(201) 279-2740
A Division of RSI/Lattice

NOW ON UNIX!



FAST-TRACK PROJECT MANAGEMENT TRACKS EVEN FASTER.

Because VUE menu-driven software gives you instant visibility into even the most complex project.

You easily control schedules, resources and budgets according to your exact requirements. VUE even lets you output a variety of reports, bar charts and flow diagrams directly to a CRT, printer or plotter.

We're also proud to say you can get VUE on-line and working in just one day. It's that easy.

So, whether you're in construction, aerospace, electronics, manufacturing or data processing, give us a call. We'll show you how VUE will keep your project on track every step of the way.

VUE.
For Enlightened Project Management.

For HP 3000, IBM PC/PCjr, Fortune UNIC, Perkin Elmer, VAX (VMS & UNIC), DEC 10 & 20, PDP-11, most Honeywell systems, and also available nationally on timesharing.

For more information send to: 2030 W Town Center Lane, #100, Cupertino, CA 95014 Call 408/257-7700 Tlx 760003



NATIONAL
INFORMATION
SYSTEMS, INC.

Name _____
Company _____
Address _____
CPU _____ Phone _____

Joan Yates is founder and president of Yates Ventures, Inc., a market research firm based in Los Altos, Calif. She is the author of the Business Guide to Unix Systems, the Business Guide to the Xenix System, the Programmer's Guide to the Unix System and the Programmer's Guide to the Xenix System.



CCI THRUSTS UNIX TO THE NEXT POWER!

The new CCI
POWER6/32™
Computer System puts
UNIX into hyperformance!

Give your next UNIX-based system
the power it's hungry for with
CCI's new power—the CCI
POWER6/32 Computer System.

The central processing unit and
overall system architecture of the
POWER6/32 were built from the
ground up, exclusively for the UNIX
operating system.

And it outperforms all the top
superminis, making it the ideal
system for your application devel-
opment needs.

0 to 6/32 in one microsecond!

The POWER6/32 delivers from
four to eleven times the throughput
of the VAX™ 11/780 on popularly
accepted benchmarks!

The CCI POWER6/32's central
processor is CCI's proprietary
design and utilizes proven
Schotlz bit-slice technology. It fea-
tures 100ns CPU cycle time, vir-
tual memory/demand paging,
and a dedicated 40 Mbyte/
second memory bus. Hardware
assists boost call and return
instructions execution to one
microsecond...the bursts of
power you need to design your
strongest UNIX programs yet!

UNIX never had it so good!

All the benefits of UNIX are made
even more powerful when the CCI
POWER6/32 takes over. It takes
UNIX to the state of the art, com-
plete with all the Berkeley
enhancements. UNIX System V
with Berkeley 4.2 BSD gives you
enhanced networking facilities to
support multiple high-speed pro-
tocols, more powerful develop-
ment tools, a high-performance
interprocess communications
facility, and an enhanced file
system.

And the CCI POWER6/32
doesn't only far surpass the com-
petition in benchmarks...we've
seen the difference it brings to real-
world UNIX-based software... In
short, it gives you enormous new
power to help you get the job done.

Hyperformance, and hypervalue!

The power is ready for you...now.
And at a price that you can easily
integrate into your design. When
you're finished, you'll end up with
even more than an unbelievably
capable supermini/computer
system.

CCI's OFFICEPOWER® Office
Automation System and
TELEPOWER® products for the
telephone industry are now avail-
able on the POWER6/32.

The CCI POWER6/32 will give you
a system that's uniquely yours.

Call CCI toll-free at
800-833-7477 (NYS call
716-482-5000), or write
Computer Consoles Incorporated,
Dept. P23, 97 Humboldt St.,
Rochester, NY 14603.



COMPUTER
CONSOLES
INCORPORATED

UNIX systems you can call your own.

OFFICEPOWER® and TELEPOWER® are registered
trademarks of Computer Consoles Incorporated.
POWER6/32 is a trademark of Computer Consoles.
VAX is a trademark of DEC Bell Laboratories.
*VME is a trademark of Digital Equipment Corporation.



the kind of technology needed in an operating system for 16-bit processors and beyond. Unix was portable, encouraged the development of portable applications, and offered advanced system facilities and true multiuser capability. It also provided superior software development environment. These features were recognized as necessary to the development of applications which would enable micros to compete in mini-dominated markets.

So much went so wrong so fast in the development of a multiuser systems market that it is not possible to trace all the events or follow any chronological order. In order of importance, the first problem was the entry of IBM into the microcomputer fray. The market had employed what was, by comparison, ordered growth and development limited by the pro-

duction and marketing resources of the relatively small players in the game. IBM infused a production and marketing potential that upset the delicate allocation of scarce development resources for both software and hardware.

Most software houses shifted to producing software to support the new "IBM market" — which was, of course, a single-user market based on the then-new MS-DOS operating system. Hardware manufacturers immediately saw that IBM was defining a new class of machine that would open entirely new markets for computers and so shifted engineering and manufacturing resources to allow them to move in on the opportunity.

The second problem was that there is no standard interface for hardware manufacturers to develop machines that were adequate to run Unix. The mini market

discovered through many years of design trial and error that multiuser time-sharing systems really needed specialized hardware technology if they were to operate reliably and efficiently. Micro builders had never been faced with this problem.

Companies that were accustomed to producing entirely new designs within a year found themselves with out products two years after project inception; and once they finally had a product that worked well enough, they found it necessary to start new designs immediately, incorporating what they had learned developing their original computers. This situation drained the resources of both hardware and software developers. Third-party and in-house software developers had to try to keep pace with (and find the deficiencies in) what the hardware manufacturers

were coming up with — through iteration after iteration.

As a result, the resources available to work on multiuser projects weren't sufficient to get products out anywhere near when the market expanded, and the disparity in size and emphasis between the single-user and multiuser markets continued to grow.

The third problem was the choice of the Zilog, Inc. 28000 as the initial engine by most of the pioneers of systems based on Unix — and that chip's eventual demise as a major element in the general-purpose, 16-bit microcomputer market.

The choice of the 28000 was logical. As a RISC processor closely emulating the architecture of the Digital Equipment Corp. PDP-11 from which Unix was being ported. The Motorola, Inc. 68000 was seen as perhaps the best of the three chips available for running a system based on Unix because it offered capabilities

Extend the power and performance of UNIX with CS XTEND

Cincom Systems, the industry leader in data base/data communication software systems, passes the power of its proven high performance software technologies for mainframe and minicomputers to the world of UNIX. CS/XTEND, our new fully integrated family of development and decision support components, makes it easy to create and implement even the most complex applications. And, our experience and expertise in developing quality software ensure that you get the high performance you need while using a minimum of machine resources.

CS/XTEND includes integrated solutions for professional system developers as well as productivity tools for non-technical information users:

CS/DBX—a high-performance shared Data Base Executive with the power to handle multiple users concurrently accessing any number of files.

CS/XPORT—a Distributed System Interface that links computers so they can share data, providing the foundation for distributed data base networking.

UNIX is a trademark of AT&T Bell Laboratories

CS/TMX— a powerful Terminal Management Executive that simplifies interactive programming by making programs independent of the terminal, and provides overall network management.

CS/RME—an easy-to-use Retrieval Management Executive that provides relational access to the data base for interactive inquiries and report writing by both end-users and computer professionals.

CS/XPRESS—a dynamic Application Builder that lets non-programmers automatically generate, maintain and access custom-built files of information.

CS/XTEND is fully compatible with Cincom's TOTAL® Data Base Management System. That means you can implement applications to operate on different types of computers using identical data base techniques.

Find out today how CS/XTEND extends the power and performance of your UNIX system. Simply call or write, Cincom Ventures Division, 2300 Montana Avenue, Cincinnati, Ohio 45211.

800-543-3010 (In Ohio: 513-661-6000)



Cincom Systems

Excellence in Software Technology.

The "Unix market" is a bit of a misnomer.

even beyond the PDF-11. However, the part wasn't ready for mass application, and there was no software support — even in the way of development tools.

But the 28000 itself took three critical blows: IBM's choice of the 6060-compatible 8088 processor, which diverted software development away from the 28000; the problems faced by the engineers in getting a reliable memory management unit, which allowed the 68000 to catch up; and the failure of Zilog itself to produce the needed support chips in a timely fashion, which would have gotten 28000-based systems to market much sooner.

Again, the net impact of this disaster was to waste precious hardware and software engineering resources on efforts that resulted in what were marginally successful products at best — certainly none that created anything resembling a multiuser market of critical mass.

Despite the difficulties, the advanced multiprocessor, 8-bit multiuser systems and the dedicated Unix pioneers (Altos Computer Systems, Dynix Systems, Inc., Prime Computer, Inc., Phoenix Systems Corp.) captured roughly 10% of the total market for desktop or larger microcomputer systems for business. This market segment represented the best chance that small microcomputer companies and their vertical application-oriented, value-added resellers and distributors had to create the kind of unique added value that would assure their long-term viability. This segment of the market also supported higher prices on hardware and software, allowing the smaller companies to compete profitably even though they didn't have the economies of scale of the larger companies competing in the much larger single-user market.

The "Unix market" is a bit of a misnomer. There are more than two dozen different operating system products based on Unix technology that populate what is termed, the

"No If, Ands, or Buts, **MicroAge®** Is The Leader In XENIX Multi-User Technology!"

When You Want XENIX, You Want Us!



MicroAge has been selling and installing XENIX based applications long before the competition was around. Our years of XENIX experience has taught us how to make the system work for the people who do the work.

If you need XENIX programming tools or high performance multi-user applications...you want MicroAge for the system and the system support you need!

MicroAge has been selling and installing XENIX based applications long before the competition was around. Our years of XENIX experience has taught us how to make the system work for the people who do the work.

If you need XENIX programming tools or high performance multi-user applications...you want MicroAge for the system and the system support you need!

MicroAge® "The Solution Store"

THE MicroAge® NETWORK

CANADA

Ontario
2612 Yonge St.
Toronto
(416) 485-5750
1400 Dundas Street East
Mississauga
(416) 277-0001
7000 Woodlawn Avenue
Markham
(416) 475-7722
One First Street
St. Catharines
(416) 685-3776

215 King Street West,
Montreal
(514) 873-3771
16, Avenue du canal South,
London
(519) 673-8846

Quebec
105 W. Sherbrooke
Montreal
(514) 875-1115

British Columbia

3421 W. 10th at Dunbar St.,
Vancouver
(604) 222-4340

Puerto Rico
255 Police Delacore Ave.
Hato Rey
(787) 754-5300

Alaska
2440 New Second Hwy
Anchorage
(907) 276-9488

1200 East Cypress,
Anchorage
(907) 273-4240

2477 Mendenhall Loop Rd.
Juneau
(907) 586-3700

100 Elm Street Highway
Fairbanks
(907) 456-7530

Arizona

24 White Camelback,
Phoenix
(602) 245-0885
2394 North 30th Street
Scottsdale
(480) 947-7841

100 South Dobson,
Phoenix
(602) 875-1195
4128 North Oracle,
Tucson
(520) 747-4825

1405 N. 21st Street
Phoenix
(602) 957-0460
1000 E. 43rd Street
Phoenix
(602) 264-9777

Arkansas
101 Ridge Ave.,
Ft. Smith
(501) 782-7285

California
104 Whittier Blvd.,
Los Angeles
(213) 636-4915
9515 Wilshire Blvd.,
Beverly Hills
(310) 652-7770

5725 E. 21st Street,
Long Beach
(310) 954-6649

Connecticut
145 Main Street,
Danbury
(203) 529-6271

330 Main Avenue,
Norwalk
(203) 851-7785

100 Main Avenue,
New Haven
(203) 734-3344

2279 North Rock Turnpike,
Fairfield
(203) 351-3644

581 E. 4th Ave.,
New Haven
(203) 546-2983

201 E. Congress,
Hartford
(203) 562-4648

100 Connecticut Blvd.,
Pomfret Beach
(203) 875-7000

Illinois

1205 Forest Park,
Niles Park Beach
(312) 585-2799
1000 Monroe,
Springfield Rd.,
Springfield
(419) 254-2884

2160 E. Canisteo Rd.,
Carbondale
(412) 434-8811
and 121 Canisteo Blvd.,
See Canisteo
(412) 747-4460

4665 Herrick Machine,
Folsom
(916) 354-3177
1035 Dublin Blvd.,
Dublin
(415) 829-0440

Colorado
8075 University,
Englewood
(303) 794-9360

3000 Wadsworth,
Atlanta-Cobb
(404) 555-2800

Connecticut
145 Main Street,
Danbury
(203) 529-6271

100 Main Avenue,
Norwalk
(203) 851-7785

100 Main Avenue,
New Haven
(203) 734-3344

2279 North Rock Turnpike,
Fairfield
(203) 351-3644

581 E. 4th Ave.,
New Haven
(203) 546-2983

201 E. Congress,
Hartford
(203) 562-4648

100 Connecticut Blvd.,
Pomfret Beach
(203) 875-7000

Massachusetts

101 Copley Avenue,
Needham
(312) 357-5900
241 North Wharf,
Melbourne
(312) 254-6075

101 Lakeview Boulevard,
Chestnut Hill
(312) 834-1430
225 U.S. Hwy. 19 N
Canton
(312) 799-2277

Georgia
1015 Peachtree Road, N.E.,
Atlanta-Buckhead
(404) 921-1813
1035 Peachtree Tucker Rd.,
Norcross
(404) 968-2900
1015 Peachtree
(404) 921-2900

1015 Peachtree
(404) 921-2900

Illinois
1015 Peachtree Bridge Rd.,
Buckhead
(404) 921-1813

1035 Peachtree
(404) 921-2900

1015 Peachtree
(404) 921-2900

Maryland

1015 Peachtree Road,
Baltimore
(312) 484-2777
1015 N. 77th Street,
Orlando Park
(312) 345-8000

1015 North Park Street,
Oak Lane
(312) 421-6000

Illinois
1015 Allendale Road,
Cambridge
(312) 594-5010

Massachusetts
1015 Olive Blvd.,
Forest Park
(312) 747-3644

1015 North Anthony Blvd.,
Ft. Wayne
(312) 484-2747

1015 Harrison Tucker Rd.,
Norcross
(404) 968-2900

1015 Peachtree
(404) 921-2900

Mass.

1015 Peachtree Road,
Brockton
(508) 244-0800
1015 Park Street,
Billerica
(312) 484-2777

Ohio
1015 Northland Blvd.,
Cincinnati
(513) 871-1660

1015 South Memorial Drive,
Toledo
(419) 258-2142

1015 South Peachtree Street,
Taunton
(508) 823-0239

1015 S.E. Washington Blvd.,
Barberton
(216) 572-2044

Oregon
1015 Commercial St. S.E.,
Salem
(503) 399-0534

Pennsylvania
1015 Maryland Parkway,
Las Vegas
(702) 795-1440

New Jersey
3670 East Route 70,
Cherry Hill
(609) 424-6655

1015 Highway 1 L.,
Wheat Ridge/Mitchell
(303) 278-0304

New Mexico
1015 Monroe N.E.,
Albuquerque
(505) 863-0915

New York
1015 Hyland Blvd.,
Staten Island
(212) 979-2400

Texas

1015 Highway 1 N.E.,
Houston
(713) 876-3644
1015 Cell Previews,
Houston
(713) 943-2000

1015 Southwest Previews,
Houston
(713) 270-0467
1015 Park Place,
Portsmouth
(609) 754-7577

Alabama
4999 Northern Expressway,
O'Fallon City
(314) 726-0117
1015 South Memorial Drive,
Toledo
(419) 258-2142

2800 Windley Park,
San Antonio
(512) 455-9898

1015 Preston Road,
Dallas
(214) 373-0888

1015 Commercial St. S.E.,
Seattle
(206) 786-5199

Virginia
395 Braddock Rd.,
Rosslyn
(703) 526-5199

Wisconsin
1015 Grand Point Road,
Madison
(414) 273-3332
1015 E. Michigan Street,
Milwaukee
(414) 273-4668

2675 North Mayfield Road,
Milwaukee/Milwaukee
(414) 771-0449

South Dakota
1015 10th Street,
Sioux City
(712) 224-5150

Tennessee
1015 2nd Ave.,
Nashville
(615) 223-9900

Wyoming
4015 C.R. Avenue,
Cheyenne
(307) 246-8888

The Leader In Multi-User Technology™

A SMALL BUT POWERFUL COMPUTER THE NCR TOWER



Nobody has to tell you that UNIX® is one terrific operating system.

But to get the most out of it, you need one terrific box.

That's the NCR Tower.

A LOT OF COMPUTER FOR A LOT OF PEOPLE.

The NCR Tower and Unix were made for each other. Just like Unix, the Tower is at its best in a multi-user environment.

Compare the Tower to the three-user IBM AT, for instance, and you'll find there's no comparison.

The Tower can handle up to twelve users simultaneously. And each user gets a lot more memory, a lot more storage and a lot more versatility. In short, a lot more computer. For a lot less money.

The Tower can even stand as part of a

nationwide distributed data processing network via SNA and other industry standard protocols.

Why does the Tower perform so well? Because it's built so well.

It is powered by the Motorola 68000, one of the most powerful 16-bit microprocessors around. To boost power even further, it has separate processors for disk, CRT and I/O controllers. And it comes with other guarantees of high performance like a Winchester hard disk and the Intel Multibus.* As well as a unique power failure recovery system and battery back-up that enables it to survive power outages.

Put it all together and you've got a system with a storage capacity that expands from 40 million characters to 214 million. One that can handle everything

from color graphics, electronic mail and word processing to data base management and electronic spreadsheets. And one for which programs can be written in COBOL, BASIC, Pascal, FORTRAN and "C."

UNIX FOR BEGINNERS, INTERMEDIATES AND OLD PROS.

Along with this impressive piece of hardware comes an equally impressive piece of operating software: the NCR-enhanced version of UNIX.

It's a more powerful and, at the same time, altogether more "friendly" operating system. It lets neophytes write their own programs while allowing highly experienced people the freedom to tap such resources as a cryptic command set structure.

What makes this possible is a design which features five different user interface

RFUL CASE FOR UNIX: TOWER.

levels. Called "shells," they keep users within the boundaries of their own abilities. One "shell" is for professional programmers who develop operating software; another is for EDP people who write complex application programs; a third is for system administrators; the fourth is for office procedures analysts and the fifth is for casual users (it's so simple, even a vice-president can use it).

Put simply, UNIX is a lot more valuable to a lot more people on the Tower.

INTRODUCING OFFICEWARE. A SUPER SYSTEM FOR OFFICE AUTOMATION.

A great computer deserves great application software. And that's what you get with NCR OFFICEWARE.*

One of its beauties is that it runs on

the Tower with IBM-compatible personal computers. So if you already have a slew of them, you can just hook up the Tower and supercharge them.

All of OFFICEWARE's applications are integrated. Spreadsheets, text, graphs, data entry forms, phone messages and inter-office mail can be displayed concurrently on multiple windows.

OFFICEWARE even provides a link with the mainframe.

And OFFICEWARE is easy to use. Ridiculously easy to use. SOFT KEYS and PROMPTS guide the user through all operations. Effortlessly.

Quite simply, OFFICEWARE may be the most comprehensive office automation system available today. And it's only available on the Tower, a computer with enough power and versatility to handle your needs. Both come to you from NCR, a company committed to applying innovative computer technology to today's business problems. And one which offers its customers support and service from 1,200 offices in 120 countries.

For more information about the NCR Tower and OFFICEWARE, dial us toll-free **N C R** at 1-800-CALL-NCR.

INNOVATIVE COMPUTER TECHNOLOGY. YOU CAN EXPECT IT FROM NCR.

"Unix" market." Licensed Unix-based products like Xenix, Unixplus, Zeus, For-Pro, Venix and Genix all have their differences.

Even so-called "standard" Unix products based on the same version differ somewhat in features, documentation and support. In fact, they are not strictly speaking compatible systems, since the process of porting Unix from the VAX to a micro and the process of making a commercial microcom-

puter-based product out of those VAX ports create several opportunities to introduce incompatibilities. Add in the lack of a standard medium and formats for software distribution, and even the 10% market share (assuming Unix had it all) isn't really a homogeneous base of systems for software marketing.

Enter AT&T

Now that AT&T is pouring millions into the Unix market

with products of its own, what has been the impact on applications availability?

Precious little, really. Thus far, AT&T's advertising has aroused interest and curiosity, but the uninformed are quick to discover that the Unix market has a way to go yet before it looks like or matches the popularity of the small computer market. Insiders are encouraged by the exposure Unix is getting. And with AT&T active, there's little likelihood that

Unix will go away. But thus far, no real difference has been made. AT&T is developing two (or more) programs to stimulate software development.

Actually, there are a lot of excellent applications available for one version of Unix or another. If you know where to look and if you settle on the application you need before locking yourself into a particular Unix system.

Most companies who find

themselves purchasing a system that runs a version of Unix actually were "found" by Unix — not vice versa. These companies either retained a consultant to find a solution to their computing problems or they have been contacted by a representative of some vendor application package that happens to run on some sort of Unix system. Because most of the 80,000 to 100,000 Unix-based business systems have been sold this way rather than through mass-market advertising or retail storefronts, the visibility of this software remains very low. Consequently, the perception is that there is very little software for Unix.

Profit potential

The pioneers of Unix attempted to distribute their products via retail channels, though not exclusively. These efforts were largely unsuccessful, since Unix had not yet been domesticated enough to be successful in these relatively unsophisticated retail channels. The notable exceptions were chains that specialized in providing sophisticated business solutions — such as the Control Data Business Centers and the MicroAge computer stores.

While these outlets did not set any sales records, they demonstrated that Unix-based systems could be profitable. But the extra investment they made was often too much for them to willing to make. Some chains were so disappointed by initial efforts with Unix-based systems that they are reluctant now to give them a second chance, even though far more refined versions exist.

Recognizing that only through a more visible presence could any Unix-based system be similarly accepted, Microsoft invested an effort in 1982 to produce a version of its Xenix that could be successfully marketed through retail channels. The theory was that by actually going through the drill of producing a retail version (all-new documentation, retail packaging, new user-oriented facilities), the company could provide a superior product to its OEM customers (such as Lantronics Corp., the first manufacturer to license this advanced version of Xenix for its Model 16).

Several other Unix suppliers followed suit. Now, if one looks hard enough, one can find Xenix for the IBM Personal Computer and Apple Computer, Inc. Line (distributed and supported by the Santa Cruz Operation). Unixplus for the Apple II, Unixsoft System Corp., Venix for the IBM Personal Computer (from Venturcom, Inc.) and Coherant (a Unix look-alike from Mark Williams).

Relatively few people want to buy a version of

Everything You Need To Know About UNIX . . .

UNIX EXPO

The Unix Operating System Exposition & Conference

October 16, 17, 18, 1984

Marina Expo Complex —

- ★ Exposition
- ★ Conference
- ★ Job Fair

Take advantage of all that UNIX EXPO has to offer, all in one location.

Learn To Earn at the Conference Program

A penetrating, multi-track slate of seminars focusing on the most vital technical and business areas of UNIX has been prepared by noted UNIX advocate, James Joyce, President, International Technical Seminars. Attending the conference will help you achieve a full understanding of what is destined to be the major computer operating system for the coming decades.

Expand Your Horizons At the Job Fair

PENCOM SYSTEMS, the national recognized leader in UNIX recruiting will host a special JOB FAIR AT UNIX EXPO where exhibiting firms will disseminate information regarding employment opportunities. Your career objectives can be discussed, and meetings with company representatives scheduled.

SAVE TIME! SAVE MONEY! AVOID LINES!
REGISTER FOR UNIX EXPO TODAY

UNIX EXPO

The comprehensive, practical business/learning event designed solely and specifically to address the myriad business and technical aspects of the UNIX OPERATING SYSTEM. UNIX EXPO is the national trade show that will bring ISO's, sophisticated end-users, technical personnel, OEM's, software dealers, and other resellers face-to-face with the leading suppliers to the industry at the exposition, and the leading UNIX authorities at the conference program. By attending this three day forum, you can be prepared to position yourself at the vanguard of the UNIX revolution.

Inspect - Compare - Question - Select

all of the UNIX products and services on display at the 350 booth exposition. The nation's leading suppliers of UNIX and UNIX-like hardware, software, peripherals and services are anxious to talk business with you.

Meet the Leaders in the Expanding UNIX Universe

For three days in October, New York City, the heart of the largest computer marketplace in the world, will become the core of the UNIX universe: creating an unparalleled opportunity for you to meet and exchange ideas, theories and information with your colleagues.

UNIX EXPO

Simply complete this form and drop it in the mail with payment of \$5.00 for each registration. Registration at the door will be \$10.00.]

Name _____

Title _____

Address _____

City _____ State _____ Zip _____

Please send complete seminar program information.

Please send discount hotel reservation form.

Return to:

National Expositions Co., Inc.

14 W. 49 St.

N.Y.C. 10019

Sponsored by Unisys of New York.

Unix — retail or otherwise — just to get the capabilities it offers, which do range beyond typical operating system functions. But the availability of versions of Unix suitable for retail distribution will not in itself ensure Unix will achieve retail presence. Even AT&T's Model 6300 personal computer, the only AT&T machine announced to date that will be available through retail channels, is initially only going to be available with MS-DOS (even though the machine is being advertised as "interfacing" with Unix).

AT&T is going through a painful process of discovery. It is attempting to find and certify software it can promote that runs on Unix. The company is attempting to encourage development by offering 38 machines at discount to "select" software developers.

This process is painful because AT&T is just learning how to deal with software developers.

The discount AT&T offers (20%) are substantiated cost manufacturers face with the need to stimulate development will sell a finite number of machines to software developers at a discount of 40% to 50%. In addition, to participate fully in AT&T's program (and getting information has been quite difficult), the software developer must fill out a questionnaire half-inch thick that asks for highly sensitive information, right down to the names of the individual programmers who worked on the software.

Most developers would rather not divulge such information to another

company (not even to most customers, for that matter).

Another factor garnering much publicity is the so-called alliance between AT&T and Digital Research. It is not clear that there is an effective alliance here, but Digital Research clearly has serious intentions in the area of software publishing in this market.

This program will be a boon to applications availability for Unix.

In conjunction with its retail sales program for Xenix, the Santa Cruz Operation is also pushing Xenix-based applications for retail distribution, and has initiated an independent software vendor (ISV) program to encourage and offer support to other software developers who would like to sell packaged applications through the same channels that handle Xenix.

Altos offers the Altos Software Availability Program. Developers get free discounts on hardware, training classes and visibility through a comprehensive directory made available to all Altos dealers and distributors.

Most other manufacturers are supporting value-added resellers and ISVs on a less formal basis to make sure that there is at least a credible sampling of software for their machines or version of Unix. Information is generally available through their Web sites.

The commercial Unix user's group — /usr/group — publishes a catalog of Unix applications, available from:

/usr/group, P.O. Box 8570, Stanford, Calif. 94306-0221.

It is beyond the scope of this article to produce any sort of directory of Unix applications, but the whereabouts of many more applications can be found by contacting just a few key vendors, such as Digital Research, Altos, Fortune, Unisoft, the Santa Cruz Operation, Microsoft, /usr/group, VenturaCom and AT&T.

An applications "underground" does exist. The accompanying list, drawn from the /usr/group catalog, shows the number of applications available in each category.

This tally is more meaningful when one realizes that sheer numbers don't mean much. A thousand third-rate spreadsheets don't make up for the availability of one Multiplan or Lotus 1-2-3. The thing to note about Unix-based applications (if they were developed for the Unix environment) is that by and large, they are superior in capability to their numerically superior MS-DOS counterparts.

Tally of applications available on some version of the Unix operating system

Applications category	Count
Application generators	15
Business graphics	6
Communications	67
Computer graphics	5
Consulting	54
Data base management	66
Engineering graphics	12
Financial analysis	7
General accounting	52
Industrial control	3
Office automation	3
Manufacturing	5
Point-of-sale	3
Publications	22
Spreadsheet	12
System software	92
Training and education	66
Typesetting	20
Word processing	26
Languages/compilers	106
Other largely vertical applications	83
Integrated "personal" application	3

Mark Ursino is president of Technology Services Corp. in Bellevue, Wash.

Multiply Management Power —

with MAPPS.

Let us show you how!!

- MAPPS (Management And Project Planning System) enables you to:
 - **SIMPLIFY.** Reduce a large, complex project to a model that you can manipulate MAPPS has a cut-and-paste option that won't multiply complexity (Or worse, logic errors.)
 - **BE REALISTIC.** TAILS™, the unique time processing feature, avoids artificial relationships between activities. (Realism makes using the tool worthwhile.)
 - **TAKE CHARGE.** MAPPS was specifically designed to allow the executive or manager to control Time, Cost and Resources. (What else is there?)
 - **BE YOUR OWN DATA PROCESSOR.** MAPPS lists and explores choices on a series of menus. Some require only a yes or no answer. Furthermore the versatile Select-Box Report system lets you tailor reports to meet your needs. (Paper seems to readily enough. Do your part to reduce excess paper with well focused reports.)
 - **BE FLEXIBLE.** Use any currency in the world. Or specify your work week for any activity beginning on any day of the week.
 - **ANTICIPATE.** Perform what-if experiments on the network model to see results without actually committing resources. (Our Project Simulator opens new possibilities for the manager.)
 - **HAVE A CHOICE.** MAPPS operates on Data General MV™, Digital VAX™, Wang VS™ and computers using UNIX® operating system.

* Registered Trademark for Bell Laboratories, Data General, Digital Equipment Corporation and Wang Laboratories



Mitchell Management Systems Inc.

PO BOX 1000 • 1000 N. University • Fort Lauderdale, Florida 33304-1000
Telephone: (305) 596-1000 • Fax: (305) 596-1004

WHY OUR CONTRACT PROFESSIONALS HAVE BETTER JOBS.

u n i x

UNIX is a trademark of Bell Labs.
An equal opportunity employer

Our UNIX specialists select from a variety of fascinating short-term and long-term projects. They spend their professional time profitably, working on leading-edge assignments for firms that appreciate their expertise.

If you are a UNIX specialist, call us. 1-800-449-5445.

We have available positions for firms — locally or nationwide. And we handle every detail, so you can devote yourself to professional growth and success.

Show us that you're good, and we'll take care of the rest.

MICROTEMPS — the leader in contract software professionals for UNIX and other specialties.

MICROTEMPS
A Technical Staff Company
18 Crawford Street, Needham, MA 02194-1606

SOUTHWATER - Swift delivery of UNIX & C Books

All prices quoted are "wholly returnable" if damaged or unsatisfactory	
For fastest service with credit card, call 201-256-0222	
G1	AT&T World UNIX, Internic
G2	AT&T World Wide Internet
G3	AT&T World Wide Internet
G4	AT&T Prodigy, America Online
G5	AT&T Prodigy, America Online
G6	AT&T System Gold, Internic
G7	AT&T System Gold, Internic
G8	AT&T System Gold, Internic
G9	AT&T System Gold, Internic
G10	AT&T System Gold, Internic
G11	AT&T System Gold, Internic
G12	AT&T System Gold, Internic
G13	AT&T System Gold, Internic
G14	AT&T System Gold, Internic
G15	AT&T System Gold, Internic
G16	AT&T System Gold, Internic
G17	AT&T System Gold, Internic
G18	AT&T System Gold, Internic
G19	AT&T System Gold, Internic
G20	AT&T System Gold, Internic
G21	AT&T System Gold, Internic
G22	AT&T System Gold, Internic
G23	AT&T System Gold, Internic
G24	AT&T System Gold, Internic
G25	AT&T System Gold, Internic
G26	AT&T System Gold, Internic
G27	AT&T System Gold, Internic
G28	AT&T System Gold, Internic
G29	AT&T System Gold, Internic
G30	AT&T System Gold, Internic
G31	AT&T System Gold, Internic
G32	AT&T System Gold, Internic
G33	AT&T System Gold, Internic
G34	AT&T System Gold, Internic
G35	AT&T System Gold, Internic
G36	AT&T System Gold, Internic
G37	AT&T System Gold, Internic
G38	AT&T System Gold, Internic
G39	AT&T System Gold, Internic
G40	AT&T System Gold, Internic
G41	AT&T System Gold, Internic
G42	AT&T System Gold, Internic
G43	AT&T System Gold, Internic
G44	AT&T System Gold, Internic
G45	AT&T System Gold, Internic
G46	AT&T System Gold, Internic
G47	AT&T System Gold, Internic
G48	AT&T System Gold, Internic
G49	AT&T System Gold, Internic
G50	AT&T System Gold, Internic
G51	AT&T System Gold, Internic
G52	AT&T System Gold, Internic
G53	AT&T System Gold, Internic
G54	AT&T System Gold, Internic
G55	AT&T System Gold, Internic
G56	AT&T System Gold, Internic
G57	AT&T System Gold, Internic
G58	AT&T System Gold, Internic
G59	AT&T System Gold, Internic
G60	AT&T System Gold, Internic
G61	AT&T System Gold, Internic
G62	AT&T System Gold, Internic
G63	AT&T System Gold, Internic
G64	AT&T System Gold, Internic
G65	AT&T System Gold, Internic
G66	AT&T System Gold, Internic
G67	AT&T System Gold, Internic
G68	AT&T System Gold, Internic
G69	AT&T System Gold, Internic
G70	AT&T System Gold, Internic
G71	AT&T System Gold, Internic
G72	AT&T System Gold, Internic
G73	AT&T System Gold, Internic
G74	AT&T System Gold, Internic
G75	AT&T System Gold, Internic
G76	AT&T System Gold, Internic
G77	AT&T System Gold, Internic
G78	AT&T System Gold, Internic
G79	AT&T System Gold, Internic
G80	AT&T System Gold, Internic
G81	AT&T System Gold, Internic
G82	AT&T System Gold, Internic
G83	AT&T System Gold, Internic
G84	AT&T System Gold, Internic
G85	AT&T System Gold, Internic
G86	AT&T System Gold, Internic
G87	AT&T System Gold, Internic
G88	AT&T System Gold, Internic
G89	AT&T System Gold, Internic
G90	AT&T System Gold, Internic
G91	AT&T System Gold, Internic
G92	AT&T System Gold, Internic
G93	AT&T System Gold, Internic
G94	AT&T System Gold, Internic
G95	AT&T System Gold, Internic
G96	AT&T System Gold, Internic
G97	AT&T System Gold, Internic
G98	AT&T System Gold, Internic
G99	AT&T System Gold, Internic
G100	AT&T System Gold, Internic
G101	AT&T System Gold, Internic
G102	AT&T System Gold, Internic
G103	AT&T System Gold, Internic
G104	AT&T System Gold, Internic
G105	AT&T System Gold, Internic
G106	AT&T System Gold, Internic
G107	AT&T System Gold, Internic
G108	AT&T System Gold, Internic
G109	AT&T System Gold, Internic
G110	AT&T System Gold, Internic
G111	AT&T System Gold, Internic
G112	AT&T System Gold, Internic
G113	AT&T System Gold, Internic
G114	AT&T System Gold, Internic
G115	AT&T System Gold, Internic
G116	AT&T System Gold, Internic
G117	AT&T System Gold, Internic
G118	AT&T System Gold, Internic
G119	AT&T System Gold, Internic
G120	AT&T System Gold, Internic
G121	AT&T System Gold, Internic
G122	AT&T System Gold, Internic
G123	AT&T System Gold, Internic
G124	AT&T System Gold, Internic
G125	AT&T System Gold, Internic
G126	AT&T System Gold, Internic
G127	AT&T System Gold, Internic
G128	AT&T System Gold, Internic
G129	AT&T System Gold, Internic
G130	AT&T System Gold, Internic
G131	AT&T System Gold, Internic
G132	AT&T System Gold, Internic
G133	AT&T System Gold, Internic
G134	AT&T System Gold, Internic
G135	AT&T System Gold, Internic
G136	AT&T System Gold, Internic
G137	AT&T System Gold, Internic
G138	AT&T System Gold, Internic
G139	AT&T System Gold, Internic
G140	AT&T System Gold, Internic
G141	AT&T System Gold, Internic
G142	AT&T System Gold, Internic
G143	AT&T System Gold, Internic
G144	AT&T System Gold, Internic
G145	AT&T System Gold, Internic
G146	AT&T System Gold, Internic
G147	AT&T System Gold, Internic
G148	AT&T System Gold, Internic
G149	AT&T System Gold, Internic
G150	AT&T System Gold, Internic
G151	AT&T System Gold, Internic
G152	AT&T System Gold, Internic
G153	AT&T System Gold, Internic
G154	AT&T System Gold, Internic
G155	AT&T System Gold, Internic
G156	AT&T System Gold, Internic
G157	AT&T System Gold, Internic
G158	AT&T System Gold, Internic
G159	AT&T System Gold, Internic
G160	AT&T System Gold, Internic
G161	AT&T System Gold, Internic
G162	AT&T System Gold, Internic
G163	AT&T System Gold, Internic
G164	AT&T System Gold, Internic
G165	AT&T System Gold, Internic
G166	AT&T System Gold, Internic
G167	AT&T System Gold, Internic
G168	AT&T System Gold, Internic
G169	AT&T System Gold, Internic
G170	AT&T System Gold, Internic
G171	AT&T System Gold, Internic
G172	AT&T System Gold, Internic
G173	AT&T System Gold, Internic
G174	AT&T System Gold, Internic
G175	AT&T System Gold, Internic
G176	AT&T System Gold, Internic
G177	AT&T System Gold, Internic
G178	AT&T System Gold, Internic
G179	AT&T System Gold, Internic
G180	AT&T System Gold, Internic
G181	AT&T System Gold, Internic
G182	AT&T System Gold, Internic
G183	AT&T System Gold, Internic
G184	AT&T System Gold, Internic
G185	AT&T System Gold, Internic
G186	AT&T System Gold, Internic
G187	AT&T System Gold, Internic
G188	AT&T System Gold, Internic
G189	AT&T System Gold, Internic
G190	AT&T System Gold, Internic
G191	AT&T System Gold, Internic
G192	AT&T System Gold, Internic
G193	AT&T System Gold, Internic
G194	AT&T System Gold, Internic
G195	AT&T System Gold, Internic
G196	AT&T System Gold, Internic
G197	AT&T System Gold, Internic
G198	AT&T System Gold, Internic
G199	AT&T System Gold, Internic
G200	AT&T System Gold, Internic
G201	AT&T System Gold, Internic
G202	AT&T System Gold, Internic
G203	AT&T System Gold, Internic
G204	AT&T System Gold, Internic
G205	AT&T System Gold, Internic
G206	AT&T System Gold, Internic
G207	AT&T System Gold, Internic
G208	AT&T System Gold, Internic
G209	AT&T System Gold, Internic
G210	AT&T System Gold, Internic
G211	AT&T System Gold, Internic
G212	AT&T System Gold, Internic
G213	AT&T System Gold, Internic
G214	AT&T System Gold, Internic
G215	AT&T System Gold, Internic
G216	AT&T System Gold, Internic
G217	AT&T System Gold, Internic
G218	AT&T System Gold, Internic
G219	AT&T System Gold, Internic
G220	AT&T System Gold, Internic
G221	AT&T System Gold, Internic
G222	AT&T System Gold, Internic
G223	AT&T System Gold, Internic
G224	AT&T System Gold, Internic
G225	AT&T System Gold, Internic
G226	AT&T System Gold, Internic
G227	AT&T System Gold, Internic
G228	AT&T System Gold, Internic
G229	AT&T System Gold, Internic
G230	AT&T System Gold, Internic
G231	AT&T System Gold, Internic
G232	AT&T System Gold, Internic
G233	AT&T System Gold, Internic
G234	AT&T System Gold, Internic
G235	AT&T System Gold, Internic
G236	AT&T System Gold, Internic
G237	AT&T System Gold, Internic
G238	AT&T System Gold, Internic
G239	AT&T System Gold, Internic
G240	AT&T System Gold, Internic
G241	AT&T System Gold, Internic
G242	AT&T System Gold, Internic
G243	AT&T System Gold, Internic
G244	AT&T System Gold, Internic
G245	AT&T System Gold, Internic
G246	AT&T System Gold, Internic
G247	AT&T System Gold, Internic
G248	AT&T System Gold, Internic
G249	AT&T System Gold, Internic
G250	AT&T System Gold, Internic
G251	AT&T System Gold, Internic
G252	AT&T System Gold, Internic
G253	AT&T System Gold, Internic
G254	AT&T System Gold, Internic
G255	AT&T System Gold, Internic
G256	AT&T System Gold, Internic
G257	AT&T System Gold, Internic
G258	AT&T System Gold, Internic
G259	AT&T System Gold, Internic
G260	AT&T System Gold, Internic
G261	AT&T System Gold, Internic
G262	AT&T System Gold, Internic
G263	AT&T System Gold, Internic
G264	AT&T System Gold, Internic
G265	AT&T System Gold, Internic
G266	AT&T System Gold, Internic
G267	AT&T System Gold, Internic
G268	AT&T System Gold, Internic
G269	AT&T System Gold, Internic
G270	AT&T System Gold, Internic
G271	AT&T System Gold, Internic
G272	AT&T System Gold, Internic
G273	AT&T System Gold, Internic
G274	AT&T System Gold, Internic
G275	AT&T System Gold, Internic
G276	AT&T System Gold, Internic
G277	AT&T System Gold, Internic
G278	AT&T System Gold, Internic
G279	AT&T System Gold, Internic
G280	AT&T System Gold, Internic
G281	AT&T System Gold, Internic
G282	AT&T System Gold, Internic
G283	AT&T System Gold, Internic
G284	AT&T System Gold, Internic
G285	AT&T System Gold, Internic
G286	AT&T System Gold, Internic
G287	AT&T System Gold, Internic
G288	AT&T System Gold, Internic
G289	AT&T System Gold, Internic
G290	AT&T System Gold, Internic
G291	AT&T System Gold, Internic
G292	AT&T System Gold, Internic
G293	AT&T System Gold, Internic
G294	AT&T System Gold, Internic
G295	AT&T System Gold, Internic
G296	AT&T System Gold, Internic
G297	AT&T System Gold, Internic
G298	AT&T System Gold, Internic
G299	AT&T System Gold, Internic
G300	AT&T System Gold, Internic
G301	AT&T System Gold, Internic
G302	AT&T System Gold, Internic
G303	AT&T System Gold, Internic
G304	AT&T System Gold, Internic
G305	AT&T System Gold, Internic
G306	AT&T System Gold, Internic
G307	AT&T System Gold, Internic
G308	AT&T System Gold, Internic
G309	AT&T System Gold, Internic
G310	AT&T System Gold, Internic
G311	AT&T System Gold, Internic
G312	AT&T System Gold, Internic
G313	AT&T System Gold, Internic
G314	AT&T System Gold, Internic
G315	AT&T System Gold, Internic
G316	AT&T System Gold, Internic
G317	AT&T System Gold, Internic
G318	AT&T System Gold, Internic
G319	AT&T System Gold, Internic
G320	AT&T System Gold, Internic
G321	AT&T System Gold, Internic
G322	AT&T System Gold, Internic
G323	AT&T System Gold, Internic
G324	AT&T System Gold, Internic
G325	AT&T System Gold, Internic
G326	AT&T System Gold, Internic
G327	AT&T System Gold, Internic
G328	AT&T System Gold, Internic
G329	AT&T System Gold, Internic
G330	AT&T System Gold, Internic
G331	AT&T System Gold, Internic
G332	AT&T System Gold, Internic
G333	AT&T System Gold, Internic
G334	AT&T System Gold, Internic
G335	AT&T System Gold, Internic
G336	AT&T System Gold, Internic
G337	AT&T System Gold, Internic

MCBA introduces shrink-to-fit software.

With nine years in minicomputer software, 15,000 installations worldwide and an established reputation in the mini world, MCBA is proudly shrinking its software line.

Down to micro size.

We've taken the impressive power of minicomputer software and made it available for micros. Right now.

Alter the fit? Absolutely.

Alter the functionality, modularity and capability? Not one bit...so to speak.

This new line of serious microcomputer software is by far the most comprehensive, well-tested and sophisticated in the industry today. By whose standards? Thousands of MCBA users who rank it the best in the business.

MCBA's library of 16 integrated manufacturing, distribution and accounting packages can be installed in whatever combination

and sequence a user needs for his or her business.

It grows with businesses. No matter what size they are now. Or want to be later.

And MCBA software now runs in RM/COS® PC-DOS, UNIX™ and UNIX look-alike environments.

In other words, we've tailor-made our newest software to fit micros—as comfortably as it fits user needs.

So whether you're a dealer or a user, find out about it. Call us now at (818) 957-2900.

Shrink-to-fit software.
For growing businesses.

MCBA®

Minicomputer Software for Micros.

2441 Honolulu Avenue, Montrose, California 91020

Also for DEC, Wang, HP, TI, and Perkin-Elmer minis.

MCBA is a registered trademark of MCBA, Inc. UNIX is a trademark of AT&T. RM/COS is a registered trademark of Ryan-McFarland Corp.

External

UNIX TO UNIX NETWORKS

Unix and networking have been close associates for much of the operating system's history. Given Unix's origins within AT&T, it is not surprising that support for file transfers and remote system access across the public network appeared in fairly early versions.

The prominent early role of Unix in universities and research labs, many of them connected through the Defense Department's Advanced Research Projects Agency Network (Arpanet), encouraged further development of Unix communications software. Today, a well-established network of Unix developers and "gurus" communicates through a mail system that carries thousands of messages a day.

Availability of Unix on low-cost microcomputer systems and the falling cost of local-area network technology combined to create a new focus for Unix networking over the last several years. Unix-based networks are emerging as an effective way to interconnect several low-cost Unix systems within a facility. From an early role connecting development systems, these net-

works have moved to commercial stature, linking micros in end-user installations. Several of the leading Unix-based system manufacturers now offer local-area networking products.

The networking software available today is characterized by diversity rather than standardization. Some software packages offer a networking base on which the user can construct his own network applications. Others focus on end-user networking utilities. Some approaches stress vendor independence and even operating system independence. Others emphasize ease of use and performance.

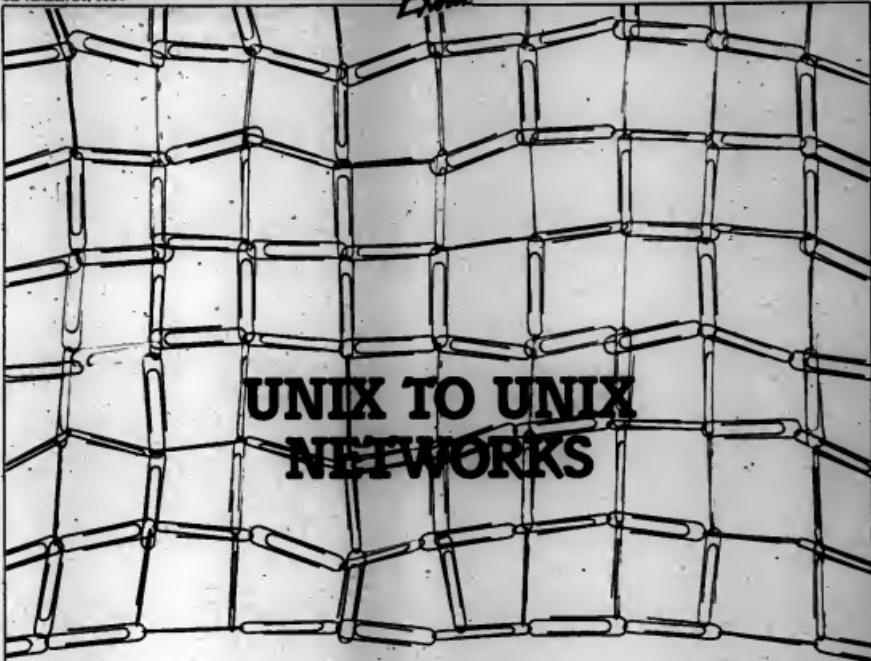
Some of the earliest work adapting Unix to local-area networks took place at the University of California at Berkeley, famous for its virtual memory implementation of Unix. Berkeley networking support was outlined in 1981 and implemented in the 4.2 BSD version, distributed this year. Sun Microsystems, Inc. implemented Berkeley networking commercially in its line of Unix-based workstations.

Berkeley networking focuses on interprocess communications services. These services allow an ex-

ecuting Unix program (a process) to communicate interactively with another process executing on another system in the local-area network. Two types of communications are supported: datagrams, in which a one-time "message" is sent, and virtual circuits, in which a semipermanent connection is established for dialogue. The interprocess communications services form a networking foundation for use in implementing a user's own applications.

The Berkeley services are implemented by extending the Unix kernel with new system calls for interprocess communications support (see Figure 1 on Page 52). This approach offers the performance advantage of tightly integrated operating system code for networking. Its disadvantage is that networking applications must be specifically written to use the Berkeley version of Unix and will not work on other versions. In fact, AT&T's System V includes a different, incompatible scheme for interprocess communications within a single Unix system.

Another Unix networking package based on interprocess communications is Fusion, from Network



3

Advantages of APECS®/6000 for your project management needs

1

Project management, financial management, graphics, and report writing all in one system.

Or any combination, with the same system, same range of capabilities. Running under the UNIX® operating system, APECS®/6000 is the most versatile project management system available today.

Designed to grow along with your needs, APECS®/6000 is the perfect solution for multi-site locations, for small projects growing larger, for the whole range of project needs.

2



Now, all project data forms an information pool from which related data can be drawn, manipulated and reported.

You can efficiently store and retrieve interrelated data, make workflow and other changes to the project data base dynamically.

With the relational DBMS, you can share data between all related management planning and control disciplines such as materials control, document tracking, equipment utilization, critical path analysis, earned value analysis, maintenance management, estimating, financial consolidation, general cost management, word processing, electronic mail, and many others.

Information can be shared with computers, workstations, processing can be done through ADP's communications network (satellite), or through your own.

3

ADP can help you design your own system, or help you purchase.

Through a network of offices, ADP can help you design, build, and implement your own system.

Or, if you prefer, ADP can help you buy a system. ADP has the experience and expertise needed for state-of-the-art systems. ADP specialists share the knowledge and expertise to build the system you require.

View how the three steps ADP follows are working...

• You choose the computing power that best suits your current needs, and then move up when needs change.

• You get the value of shared information with relational DBMS.

• You can always keep track of the "big picture" and at the same time keep control of the details with APECS®/6000's powerful summarization capabilities.

• You get single source accountability from ADP.

Learn how APECS®/6000 can enhance all your upcoming projects. Contact us now and ask for Project Information Kit #1. Take

Research Corp. Like the Berkeley software, Fusion offers a "socket driver" that allows application programs executing on different systems in an Ethernet network to communicate.

Fusion also includes a set of administration utilities that were designed for the end user rather than the programmer. The utilities support file transfer, network mail and remote login, as well as various network ad-

ministration functions.

Unlike the Berkeley approach, Fusion works with an unmodified Unix kernel. Low-level network services are implemented within an Ethernet driver, which can be implemented in different Unix® versions as easily as other Unix device drivers. User-level network functions are implemented in a collection of utilities that execute as ordinary Unix applications programs.

The advantage of this architecture is vendor independence. Fusion not only works with different versions of Unix (Version 7, System III, System V, Berkeley and others), but it is also available for use with Digital Equipment Corp.'s VAX/VMS and Microsoft Corp.'s MS-DOS. Fusion can thus be used to connect very different systems on a single local-area network.

These advantages come at the expense of a less elegant programmer's interface to the interprocess communications services and, presumably, some performance loss.

Vendor-independent approaches that rely on file transfer utilities also have a drawback: they lack interprocess transparency. A secretary processing packages on a local system, for example, must be trained to use new network commands and file transfer utilities to access documents on a remote system. Further, while copying files to a local system may be adequate for some applications, it is completely unsatisfactory for others. An example is shared access to an on-line invento-

ry data base from multiple systems in a local-area network.

Several software developers have specifically addressed the problem of shared, interactive file access across a Unix local network by creating a distributed Unix file system on the network. The option behind the distributed file system concept is simple—extend the hierarchical Unix system on one local machine on the network to include the file hierarchies on other systems in the network.

An obvious way to achieve

Now Affordable Power and Performance

Get all the power you need and all the performance you want from a computer system unmatched in its class—of course, in a different price class.

The MS-8 combines the processing speed, large instruction space and sophisticated instruction set of the Motorola 68010 processor with the wide variety of peripherals available and fully supported under UNIX® 4.0/20. The MS-8 system features 1.22 MIPS processing, 32 MB memory, 16 Mbytes of disk, and the ability to expand the high-speed memory to a megabyte of dual-port or wait state memory.

Basic configuration of the MS-8 system is: CPU, 28 MHz memory, 10 user, 40 MB removable disk drive, 75 ps, 1800 bpi tape drive, and CRAY 4 2850.

We've saved the best for last. Price for the MS-8 computer system is \$29,885. When you compare power and price, you can't afford not to have one on line system.

© 1984 Gould Electronics, Inc.
10000 University Blvd. • Cleveland, OH 44108
216-248-4253

The company that makes computers work the way you always thought they should.



Medical Informatics, Inc.
10000 University Blvd. • Cleveland, OH 44108
216-248-4253

The company that makes computers work the way you always thought they should.

In Salt Lake City UNIX PROGRAMMERS

The qualified candidate must have BS/CS, BSEE or equivalent experience and at least 4 years programming background.

Requires a strong expertise in a UNIX system environment, and knowledge of "C" programming language.

Please send resume in complete confidence to:

S. Dawson

Sperry

Microproducts Division
Employment Department

322 N. Sperry Way

Salt Lake City, Utah 84116

We are an equal opportunity employer m/f/v/h.

UNIX®

Marketing and Technical Professionals

The Hottest UNIX® Opportunities Are With Gould's Firebreathing Team In Florida!

Market Development And Product Marketing

- Product Market Management
- Market Development Management
- Promotion Management
- Product Marketing

Several UNIX®-based opportunities exist in the above areas for marketing professionals experienced in product marketing and market development in the scientific and engineering computation, software development, education and research computing marketplaces. Additional opportunities available for individuals experienced in OEM marketing. An MBA is desirable.

To discuss these SIZZLING opportunities, call us today! CALL COLLECT (305) 567-2900, Ext. 4102. If unable to call, send your resume to Jim Holden, Dept. C, GOULD INC., Microelectronics Systems Division, 8901 W. Sunrise Blvd., Ft. Lauderdale, FL 33313. An Equal Opportunity Employer, M/F/H/V.

UNIX® Development

Several opportunities are available in a fast-paced UNIX® development environment. We require individuals who have experience with UNIX® development, networking, communications, performance monitoring, multi-processor operating systems, or languages.

Regional UNIX® Sales Support

Opportunities are available in the following cities for senior level UNIX® support analysts. Located in major regional sites, you'll have responsibility for customer demos, debugging and running UNIX® benchmarks, and overseeing third party software porting efforts.

BOSTON, MA
WASHINGTON, D.C.
CHICAGO, IL
LOS ANGELES, CA

*UNIX is a trademark of
AT&T Bell Laboratories

GOULD
Electronics

SPERRY

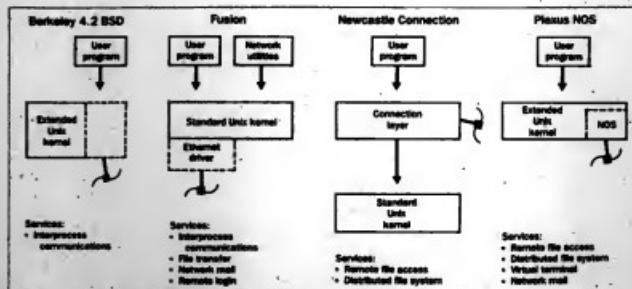


Figure 3. Architectures, capabilities of several Unix-based-area network solutions.

UNIX® EVALUATION NEWS

ARM PROCESSOR APPLICATIONS - COMMERCIAL, INDUSTRIAL AND AUTOMOTIVE

**DO YOU WANT TO
GET A JOB?**

If you have to compare incompatible Linux systems in the same environment, or even optimize the performance of your own system in terms of memory usage, multiple, slow bootups, & more like a long-distance race.

**THEORY AND
PRACTICE IN
TEACHING**

How do you decide which UNICEF projects should be the priority for your country? You could compare published country data

卷之三

If your target needs are heavily database-oriented, then you will need to transfer most of each system's distributed processing power to the database. If you need graphics capability, then the CPU needs to move to the center of execution. You might even need to add a system with a graphics processor.

1

AM Technology's expandable UWB bandwidth protocol, SAW-UWB, is designed to fit your specific wireless sensor network UWB needs. Choose from Version 2, System X, System Y, Series 1, Series 2, or Series 3. Your preference. Our expertise. AM Technology's SAW-UWB technology is a proven, reliable, low-power, cost-effective, and expandable system. It can support up to 100 nodes in a single channel and up to 10 channels in a single node. The system is designed to be highly reliable and robust, making it ideal for harsh environments.

[View Details](#)

a distributed file system is to introduce another layer of hierarchy above the individual system (see Figure 2 on Page 54). The top level (or "root") of each individual file system in the network thus becomes a subdirectory of a single, networkwide root. To locate files in a remote system, the user simply specifies a path up through the top of the file hierarchy on his local system and then down into the hierarchy on the remote system.

This distributed file system scheme is implemented in the Workstation product from Altos Computer Systems, Inc. and in the Newcastle Connection, developed at the University of Newcastle in the UK and now being marketed commercially. The Newcastle Connection supports interactive remote file access by interposing a connection layer between user programs and the Unix kernel. That layer traps requests for access to remote files and passes them across the network for completion on the remote system (see Figure 1).

While this implementation offers independence from any particular Unix version, it suffers a performance penalty when compared with modified-kernel approaches.

A different distributed file system approach is offered in the Network Operating System (NOS) of Plesus Computers, Inc. for its line of Unix-based supermicros. NOS gives users access to remote files in a local-area network by allowing any arbitrary directory or a remote system to be "attached" at any point in the local system's file hierarchy. If customer files on a system in an accounting department are to be shared with users on the marketing department's system, these files (and only those files) can be "attached" into the marketing file system (see Figure 3 on Page 54).

To users of the marketing system, the customer files appear exactly as if they were present actually on the marketing system; access is completely transparent. Veteran Unix users will recognize this scheme as a straightforward extension of the "mount/unmount" approach used by

Objective - C™

The Software IC (Integrable Component)

**Software That
Makes Hard Sense**

Finally, the sensible approach of hardware design has been applied to software.

Objective - C™ is a language that adds the concepts of messaging, objects and inheritance to any C compiler. It turns C from a program building language into a system building tool, increasing your programming efficiency by several orders.

of magnitude. With Objective -C™, software reusability is a reality and software development becomes largely a matter of reintegrating pre-tested components (Software ICs).

Objective -C™ is now available for the following machines and systems, Appollo, Fortune, HP 9000, Sun, Vax, NCR Tower, and Xena. Other configurations are under development. Call

**Productivity Products
International**
27 Glen Road
Sandy Hook, CT 06482
(203) 426-1875

Anouncing

The one-stop, international advertising service for micro marketers.



You'll reach microcomputer buyers all over the world with *Computerworld's International Marketing Service (CWMS)*. Because we

have the microcomputer market covered with an international network of publications. And what a market!

As the need for computerization in government, industry and educational systems all over the world becomes more acute, countries look to the cost-effective, adaptable microcomputer to bring them into the computer age. This means a very lucrative market for the U.S. micro marketer, since international product demand exceeds product supply.

Now, with the help of *Computerworld's International Marketing Services*, you can advertise in twenty magazines devoted exclusively to supplying information to microcomputer users in: Australia (*MicroWorld, Australian PC World*), Brazil (*MicroMundo*), Canada (*PC World Canada*), Denmark (*Micro Verden*), Finland (*Mikro*), France (*Golden, OPC*), Japan

(*PersoCom World*), Mexico (*Compu Mundo*), Norway (*Mikro Data, PC Mikrodata*), Sweden (*MicroDatorn, Min Hemdator*), Spain (*Micro Sistemas*), Sweden (*Svenska PC World*), The Netherlands (*Micro/Info*), West Germany (*MicroComputerwelt, PC Welt*,

Rum). And your advertising message can reach buyers of microcomputer products and services around the world through special micro sections in any of over 40 publications in 25 countries.

Act now—and take advantage of this international demand for microcomputer products. Whether you want to test the mar-

ket—or locate a distributor or representative—our publications will put you in touch with the right people around the microcomputer world.

For more information on getting international micro coverage, call Diana La Muraglia, General Manager, International Marketing Services, toll-free, at 800-343-6474. In Massachusetts, call 617-879-0700 or return the coupon below.



CW COMMUNICATIONS/INC.

Diana La Muraglia, General Manager
International Marketing Services
CW Communications/Inc.
375 Cochituate Road, Box 880
Framingham, MA 01701

Please send me information on your:

Microcomputer publications Your other foreign publications

Name _____ Title _____

Company _____

Address _____

City _____ State _____ Zip _____

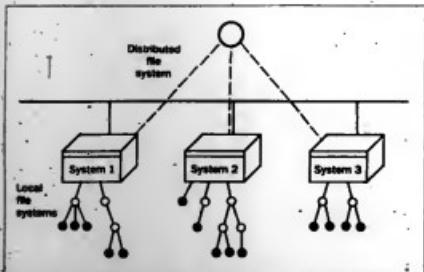


Figure 2. The Novell Connection distributed file system. The solid circles represent files and the blank circles directories.

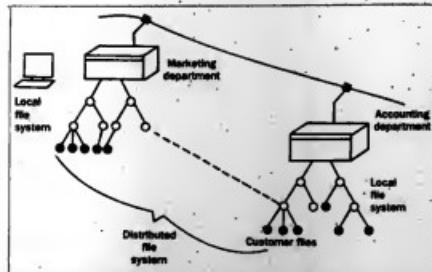


Figure 3. The Plexus NOS distributed file system, showing transparent sharing of customer files on a local-area network.

Unix to accommodate multiple local disk drives.

The major advantage of the Plexus approach is its transparency. Users of remote files do not even need to know on which remote system the files are located; all that matters is that they appear as part of the local hierarchy. In fact, the network administrator can introduce new systems in the network and move direct-

CrystalWriter

the printer for the UNIX system

S00-02-0000



SYNTACTICS

Vendors will be working toward each other, incorporating competitors' best ideas.

tories from system to system simply by changing the network "attachments," with no impact on user programs or utilities. NOS also supports full record locking and security, so interactive access to remote data bases is possible.

NOS is implemented as an extension to the Unix kernel. Remote file I/O is performed through the standard Unix read/write/open/close calls, which are transparently mapped to other systems by NOS.

The advantages of this approach are its transparency and performance. Disadvantages include its vendor-dependent restriction to the Plexus NOS kernel and the absence of user-level interprocess communications capability.

At present, the offerings of the major players, AT&T and IBM, are largely unknown. AT&T's SBNet is in its early stages, with only primitive software support available. IBM unveiled its cabling scheme but little about its local-area network software and only glimpses of its Unix strategy.

The level of ongoing development in Unix-based local-area network software is extremely high. Vendors will be working toward each other, incorporating the best ideas and features of their competitors' products. Yet standardization among approaches and vendors is far from realized.

Jim Gruff is marketing director for Plexus Computers, Inc. in Santa Clara, Calif.

Extra!

BEST BOOKS

By Jim Joyce

Every month, it seems, two or three new Unix-related publications go to press. The question asked at the Independent Unix Bookstore is no longer "Is there anything about Unix?" but "What is the best book for me?"

Here is a guide to the best books for managers, programmers, non-programmers and more advanced Unix users. Specifically omitted for space reasons are the growing

number of books on C, the language in which 98% of Unix is written. The Independent Unix Bookstore's catalog contains annotations for books about both Unix systems and C.

For managers. Managers, marketing and technical people who want to know something about Unix but do not need detailed knowledge will find Paul Weinberg and James R. Groff's *Understand-*

ing Unix: A Conceptual Guide (Que Corp., 225 pp., \$17.95 paper) the right selection. This book discusses how Unix fits into the world of computing, what its major features and benefits are and how the system is structured.

As an example of just how astute the authors are, they accurately conjectured in 1983 that Interactive Systems Corp. was at work on VM/IX, the IBM mainframe port of





Unix. VM/IX was released in mid-July.

Technical discussions of commands and shell scripts are included in Weinberg and Groff, but not at the level of detail to be found in a book for programmers. The title is "A Computer Guide," and that is what the book delivers quite well.

Programmers learning Unix. Three books tie for best choice for this audience, depending on how experienced in programming the reader is.

For highly experienced programmers who may already know something about Unix from trade publications, Steven Bourne's *The Unix System* (Addison Wesley, \$49 pp., \$16.95 paper) is the book to read. Bourne wrote the standard shell, the command interpreter corresponding to job control language on other sys-

tems. Those who thread their way through the tennis ladder example in this book will truly know the power of Unix utilities and the shell as a programming language.

Those needing a more introductory book should consider choosing either Henry McGilton and Rachel Morgan's *Introducing the Unix System* (McGraw-Hill, 656 pp., \$19.95 paper) and Mark Sobell's *A Practical Guide to the Unix System* (Benjamin/Cummings, 428 pp., \$21.95 paper).

Both are carefully crafted, with clear examples showing how to make use of Unix's power. Sobell's book shows what can be done with a thoughtful use of Unix tools and a few basic group processes. McGilton and Morgan include a chapter on system administration for readers who have one of the many micro-based Unix systems now available.

Unix for nonprogrammers. Just which book is the best for a nonprogrammer depends on the meaning of the term and what the reader wishes to learn.

A senior systems analyst may well find McGilton and Weinberg's book quite satisfactory as a guide to the scope of Unix's power.

Selective reading of McGilton and Morgan or Sobell can provide a nonprogrammer with a working knowledge of the system's word processing capabilities.

Nonprogrammers in a Berkeley Unix environment may find *Unix Primer Plus* by Mitchell Waite, Donald Mauro and Steve Prinz (Sams, Co., 414 pp., \$19.95 paper) a pleasant way to learn the system. However, the Berkeley 4.2 Unix emphasis will be frustrating to those on systems that do not include Berkeley enhancements.

Intermediate Unix.

Without a doubt, the *Unix Programming Environment* (Prentice-Hall, 367 pp., \$19.95 paper) by Brian Kernighan and Rob Pike is a must-read book for anyone seriously interested in writing effective programs. This is a book of philosophy disguised as a technical book. It is technical, to be sure, but its strength lies in the thinking they do about the Unix programming environment.

The script for the "pick" utility and the discussion of it are worth the price of the book alone. Programmers who add features to programs will want to study the discussion carefully to see a very different approach to Unix is genuine increase in functionality.

Unix internals. Unix source code, one soon finds, is protected by trade secrets, and anyone who has had access to source code is bound by signed agreement not to reveal the code to those who have not signed such a nondisclosure agreement.

Thus, Douglas Comer's *Operating System Design: The Unix Approach* (Prentice-Hall, 472 pp., \$29.95 hard-bound) cannot, of course, be Unix source in book form. That Xnu is spelled backward is provocative enough, though.

The book, at the bottom line, is about operating system design, and Xnu is a Unix-like operating system. Someone with access to Unix source code could also use the book as a helpful companion for reading the code.

Guides to software and systems. These guides are available to help readers determine what Unix offers and what software and systems are available.

Bill Freiboth's *The Unix Guide* (Pacific Micro Tech, 118 pp., \$24.95 paper) is designed "to help readers determine what Unix offers." Unix Version 7, System III, System V, 4.x Berkeley Unix and Unisys' Uniplex are compared in discussion and table form. The guide is not for technicians, because they do not need it. It is for those who want to know about Unix version differences.

The */usr/group Unix Catalog Software Directory* (Oager Publishing, 198 pp., \$50 paper) describes nearly 400 applications packages from benchmark suites to Cobol compilers, accounting packages and graphics software. It should be used with the */usr/group catalog* for best results in reaching companies selling software. At the back of the directory is the promise of a hardware directory, a much-needed addition to the body of books on Unix.

Ray Jones' *The Unix Applications Software Directory* (Oager Publishing, 198 pp., \$50 paper) describes nearly 400 applications packages from benchmark suites to Cobol compilers, accounting packages and graphics software. It should be used with the */usr/group catalog* for best results in reaching companies selling software. At the back of the directory is the promise of a hardware directory, a much-needed addition to the body of books on Unix.

UNIX IS A DINOSAUR CP/M & MS-DOS ARE TOYS

MULTI SOLUTIONS PRESENTS

THE WORLD'S FIRST 4th GENERATION OPERATING SYSTEM

A SERIOUS
OPERATING
SYSTEM

S1™

FOR TODAY
AND
TOMORROW

- PORTABLE
- MODULAR
- MULTIUSER
- MULTITASKING
- MULTI PROCESSING
- PARALLEL PROCESSING
- 64 CHARACTER NAMES
- 3 COMMAND PROCESSORS
- REAL TIME

- PERTURBING
- DISTRIBUTED PROCESSING
- HIERARCHICAL DIRECTORIES
- REUSABLE FILES
- B-tree
- VSAM
- RECORD LOOKING
- UNIX SOURCE COMPATIBLE

- WINDOWING
- MAPPED DISPLAYS
- FULL SCREEN MANAGEMENT
- FULL SCREEN EDITING
- FULL MEMORY MANAGEMENT
- VIRTUAL MEMORY
- SEMAPHORES & LOCKS
- EXTENSIVE UTILITIES
- AND MUCH, MUCH MORE

S1 IS THE ONLY OPERATING SYSTEM WORTHY OF THE TITLE:
"THE NEXT WORLD STANDARD."

ONLY S1 DOES IT ALL.
NO OTHER OPERATING SYSTEM
COMES CLOSE. CUTS DEVELOPMENT
TIME FROM MAN YEARS TO MAN MONTHS.

Please send for additional information.

IN TIME, ONLY THE BEST WILL SURVIVE: S1



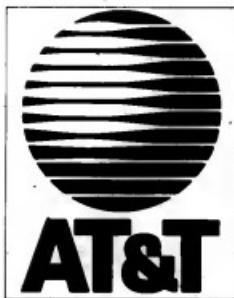
Multi Solutions, Inc.
Suite 207
123 Franklin Corner Rd.
Lawrenceville, NJ 08648
609-896-4100 Telex: 821073

*Reg. Trademarks: CP/M of Digital Research; Unix of Bell Laboratories. Trademarks: MS-DOS of Microsoft, Inc.

Jim Joyce founded the independent Unix Bookstore, 580 Waller Street, San Francisco, Calif. 94117. He is also president of International Technical Seminars, a firm specializing in Unix and C training, documentation and consulting services.

Extra!

THE USER EXPERIENCE



WHAT UNIX CAN DO

Go inside Bell Labs to see how remote voice access, digital signatures and network modeling work.

Page 60



UNIX RUNS THE OFFICE

The daily operation of a financial services subsidiary depends on terminals as much as telephones. These terminals run System V.

Page 63



UNIX GATEWAY

The Air Force Logistics Command uses an Intelligent Gateway Processor as a window to logistics information.

Page 67



Bell Labs: testing ground for Unix.

WHAT UNIX CAN DO

(Beverly Dyer, a programmer with AT&T Bell Laboratories in Short Hills, N.J., describes the digital signature project.)

One of the current limitations of electronic messaging systems is the inability to sign a message by hand.

A signature provides a legally acceptable guarantee that the owner has authorized its contents. In 1983, we began to explore this problem at AT&T Bell Laboratories, and our efforts resulted in the digital signature project.

The scheme we implemented uses the RSA public-key encryption algo-

rithm (named for its inventors, Rivest, Shamir and Adleman), in which each user is assigned both a public and a secret key. The signature technique works as follows:

1. A checksum is computed on the message to be signed. This checksum is a number that is unique enough, such that it is very difficult to generate a different message that would produce the same checksum (preventing the possibility of someone intercepting the message and changing a salary figure from \$10,000 to \$100,000).

2. The checksum is encrypted to form the signature, using the authorizer's secret key.

3. The signature is sent, along with the message, to the verifier. The verifier decrypts the signature using the authorizer's publicly known key, arriving at a number which, if correct, is the same as the original checksum. The checksum procedure is repeated on the received message, and if the two numbers are equal, the message is the same as that signed by the authorizer.

There are a number of reasons the Unix operating system was ideal for developing this project. It provides flexibility with both high- and low-level functionality.

Pieces of software used separately, in combination and as a whole needed very little modification for different applications or different processors. Prototyping the system through several stages was quick and simple. The signature procedures were written before being interfaced to our standard electronic mail system, for example, and no changes to the mail system were necessary. The programmatic interface also makes use of a package of arbitrary precision math routines that were developed on a different processor and ported to our machine with no changes. High- and low-level commands can be accessed with very little interfacing work from the programmer.

The Unix system also offers significant advantages for deployment and use of digital signature applications within Bell Labs.

The system is widely used on a variety of processors from several different manufacturers. This environment allows the digital signature applications to be deployed across these various systems with little or no conversion effort, making them accessible to a large population.

Most of the computation involved in this set of programs is spent performing arithmetic functions on very large numbers. Raising a 100-digit decimal number to the power of a number the same size requires the efficiency of assembly language. The C language allows code that is nearly as efficient as assembly language, without sacrificing portability.

Digital signatures are intended for use by a large population, and the user interface was designed to be simple. The multiprocessing capability of the Unix system allows much of the computation to be done "behind the user's back," so to speak. In our case, this background processing is involved directly by the digital signature tools, as command-line statements in the shell command language, requiring no special programming of the parts run in the background.

Commands in the shell programs can "pipe" input and output to and from the user, results of other shell commands and C programs,

SIR/DBMS... for data rich, information poor, R&D

SIR/DBMS helps market research analysts, statisticians, quality assurance engineers, medical researchers, and other knowledge workers transform R&D data into strategic information. SIR/DBMS is a complete relational database management system with special features to manage empirical and decision-oriented data. And it provides unmatched portability across a wide range of mainframes, minis, and 32-bit UNIX-based microcomputers.

SPECIAL FEATURES

- Easy ad hoc query and reporting with SQL+*
- Comprehensive data integrity and quality control
- Relational, hierarchical, or network views of data
- Direct interface to BMDP, SAS, SPSS
- Flexible report generation
- Publication-quality tabular displays
- Fast, efficient programming with a 4th generation language

UNMATCHED PORTABILITY

APOLLO	AEgis
CDC CYBER	NOS, NOS/BE
CRAY	COS/CFS
DATA GENERAL	ADS/VS
DEC VAX	OS/VS, VMS, UNIX
DEC 10/30	TOPS
GOULD SEL	S/32
HP 9000	HP-UX
HONEYWELL	CP-6, GCOS 8,
IBM & PCMS	MULTICS
ICL	VMS, VME/B,
PERKIN-ELMER	VM/CMS
PRIME	VM/32
SIEMENS	PRIMOS
SPEKKY 1100	BS2000
SPEKKY 90	EXEC
	VS/9

SIR, Inc.

SIR, Inc. has pioneered the development of database software for INFORMATION ANALYSTS in applied R&D since 1976. SIR/DBMS has been used to develop thousands of applications at R&D divisions of Fortune 500 companies, research institutions, government agencies, and universities across 25 countries. A full range of technical support and training services is available to you.

Call or write:
Director of Sales, SIR, Inc.
820 Davis Street, Evanston, IL 60201
312-475-2314

SIR/DBMS
THE choice of the knowledge worker





Honeywell and UNIX™ team up. Introducing the microSystem NX.

microSystem NX features:

- The Motorola MC 68000 Microprocessor
- Medium/High Resolution Monitor
- Unix-based UNIPLUS +™ Operating System with Window Manager:

Spreadsheet, Word Processor,
Graphics, Program Development

For complete information call 1-800-328-5111 ext 2743
(in Minnesota call collect 612 870-2142) or write Honeywell
Information Systems Inc., MS 810, 300 Concord Rd.,
Billerica, MA 01821.

Or, see MicroSystem NX at:

- INFO '84 NYC Oct. 1-4
- UNIXEXPO NYC Oct. 16-18
- FOAC Washington, D.C. Nov. 6-8
- COMDEX Las Vegas Nov. 11-14

Together, we can find the answers.

Honeywell

TODAY'S VAX FAMILY: UNPRECEDENTED COMPATIBILITY FROM THE DESK TO THE DATA CENTER.

Digital's VAX™ systems have earned an enviable reputation as the best-engineered computer family in the world. Since their introduction, VAX-11/730, VAX-11/750, VAX-11/780 processors and VAXcluster™ systems have set the industry standard for processor-to-processor compatibility.

Now VAX system compatibility has been extended to unprecedented proportions, with the addition of the new MicroVAX™ and VAX-11/725 systems at the low end, and the new VAX-11/785 system at the high end. Software is completely compatible; VMS,™ a multi-user, multi-tasking virtual operating system, runs on every

optimized for VAX system performance.

Within the VAX computer family, compatibility can range from systems that fit on a desktop and economically support a single user to systems that occupy a data center and can effectively handle the workload of your entire organization. In short, Digital's VAX computer line is the best-engineered in the world, encompassing the widest range of compatible processing solutions. So it's no wonder that VAX

systems have become the most popular 32-bit computers.

THREE NEW EXTENSIONS ENGINEERED FOR WIDE-RANGING SOLUTIONS.

The MicroVAX I system is the VAX processor for micro-computer applications. It is cost-effective enough to dedicate to just one user or process. But it's powerful enough to handle many demanding tasks because the

MicroVMS™ operating system gives you the same utilities, development aids and languages as the full VMS operating system.

The VAX-11/725 system is designed for the office. It is so compact it can fit under a desk. Yet it runs full VMS software, and



MicroVAX

VAX-11/725



VAX-11/730



VAX-11/785

VAXcluster

VAX processor. This means you can apply compatible processors – with compatible architecture, data registers, file structures, languages, utilities and networking options – to an incredible range of applications. VAX system compatibility includes UNIX™ software environments, too. In fact, Digital's VAX computer line is the first 32-bit computer series in the world to support a virtual memory implementation of UNIX software. And Digital's ULTRIX™ operating system gives you a single source UNIX software solution

VAX FAMILY COMPATIBILITY

VAX's VAX FAMILY.

MicroVAX, VAX-11/725, VAX-11/730, VAX-11/750, VAX-11/780, VAX-11/785 and VAXcluster systems.

OPERATING SYSTEMS.

VAX processors support VMS and ULTRIX operating systems.

INFORMATION MANAGEMENT.

VAX systems support the VAX Information Architecture, which includes the VAX DBMS CODASYL databases, VAX Rdb relational databases, the Common Data Dictionary, DATAREVEVE™ query language and application generator, DECgraph™ business graphics software, DECcalc™ 35mm slide generator, VAX VTX™ videotex system, FMS™ Forms Management System, TDMS Terminal Data Management System, and ACMS Application Control and Management System.

PROGRAM DEVELOPMENT.

VAX systems support APL, BASIC, BLISS, C, COBOL, CORAL 66, DIBOL™, DSM (Digital Standard MUMPS), FORTRAN, PASCAL, PL/I, RPG II, LISP, OPS5 and Digital's MACRO assembly language.

can support up to eight users. Plus it's quiet and requires no special air conditioning. It's the VAX system to choose when your applications require more memory and storage capacity than the MicroVAX I system offers today.

The VAX-11/785 system, our latest top-of-the-line VAX computer, is the highest performance processor of the VAX computer family. Cache is a full 32 thousand bytes, a special advantage if your programs contain many complex subroutines. There's also an optional floating point

accelerator for your numeric-intensive applications. And wherever floor space is a concern, the VAX 11/785 system gives you a special advantage because it fits in the same size cabinet as a VAX 11/780 processor.

VAXCLUSTER SYSTEMS: THE POSSIBILITIES ARE ENDLESS.

Even the top of the line isn't the end of the line of the VAX computer family, because you

delivering virtually unlimited computing capacity.

FLEXIBLE NETWORKING FOR TODAY AND TOMORROW.

The benefits of VAX system compatibility go far beyond expansion from one VAX processor to another, because the efficient communications options provided through Digital Network Architecture let you get the maximum benefit from all your installed systems - including

Gateways let you use dial-up or dedicated lines, Ethernet high-speed local area networks, X.25, packet-switched data networks, PBX, 2780/3780, 3270 and SNA.

ENGINEERED FOR THE LONG TERM.

The chief advantage of the architectural compatibility we've engineered into every member of the VAX computer family is the return-on-investment it gives you. You can start anywhere and

expand up or distribute down as your needs dictate. And you won't have to retrain, reprogram, restructure files or abandon the system you began with.

BEST ENGINEERED MEANS ENGINEERED TO A PLAN.

Digital's VAX computers, like all Digital hardware and software products, are engineered to conform to an overall computing strategy. This means our systems are engineered to work together easily and expand economically. Only Digital can provide you with a single, inte-

VAX 11/780

VAX 11/785

VAX 11/780

VAX 11/785

can link multiple processors together and manage them as a single unit in a VAXcluster system. This capability, which is unique in the industry, enhances data integrity, increases system availability, and does it all with complete user transparency. Moreover, it permits the resources of a single facility to be shared throughout your organization, and lets you keep pace with expanding needs through incremental system growth. As many as 16 processors and storage servers can be combined in a single VAXcluster system,

non-Digital systems.

With DECnet™ network capabilities, multiple VAX processors and VAXcluster systems can exchange messages, transfer files, update database records, execute programs and share peripheral and processor resources in local and wide-area network configurations - transparently to both the user and the program. Adaptive routing helps ensure optimum reliability and transmission efficiency. This resource-sharing can incorporate all the VAX systems you own, and many others as well.

expand up or distribute down as your needs dictate. And you won't have to retrain, reprogram, restructure files or abandon the system you began with.

The VAX computer family's unmatched applications versatility means that every area of your operations - from the factory floor to the engineering lab to the executive office - can take advantage of the unequalled value of VAX systems. The VAX Software Source Book lists many of the thousands of applications developed and supported by Digital and independent ven-

gated computing strategy direct from desktop to data center.

For more information on VAX computer systems - or if you would like to receive a complimentary copy of Digital's VAX Software Source Book and the VAX Family Brochure - contact your local Digital sales office. Or call 1-800-DIGITAL, ext. 200.

THE BEST ENGINEERED COMPUTERS IN THE WORLD.

digital™

dar" command helps track personal appointments.

The financial staff uses the Multiplan spreadsheet program for various analytic purposes. (Multiplan was developed by Microsoft Corp. and ported to the VAX Unix system by the Santa Cruz Operation.) The ease of use of Multiplan allows these noncomputer professionals to create and manipulate spreadsheet models without the aid of the programming staff.

Because of the complexity of leveraged leasing, a large software model was written locally to provide the financial staff with the economic analysis and accounting information necessary to structure lease transactions.

The reports produced by this model, bid proposals and other documents are made available to our co-

Experience has shown us that the best way to use the Unix operating system is to avoid modifying it.

investors who dial into our system for immediate access to time-critical information. Unix provides a technique for replacing the standard user interface, the shell, with a locally written program. This technique allows us to limit our co-investors to accessing just the information that is for their eyes only.

To keep track of co-investors and match potential investors with upcoming deals, a data base of pertinent information is maintained on corpo-

rations. Local front-end applications provide menu-driven, screen-oriented interfaces to the data base to retrieve information selectively, based on company name or deal characteristics, and to modify or add to the data base.

The data base and associated applications are implemented using International Technology, Inc.'s Ingres data base management system. Ingres was developed from a research prototype at the University of Califor-

nia at Berkeley and is provided with the current standard Berkeley system, BSD 4.2. Local modifications were necessary to run Ingres on AT&T Unix System 3.

A team of newly hired secretaries and financial staff is now being handled by User Training Corp.'s audio-digital "Unix System Tutorials." These courses provide excellent introductions that are truly geared for computer novices and not for programmers learning a new system. The courses contain information on basic commands, the file system, the vi editor and the Multiplan spreadsheet program. (Unfortunately, missing is a course in Multiplan.)

The student listens to the presentation on headphones connected to a special cassette deck that is also connected to his terminal. The terminal screen is used as a blackboard to emphasize topics and to show typical system responses. The student may at any time stop the cassette and put his terminal on-line to practice a new topic directly on our system. This audio-digital medium is particularly effective in teaching the use of full-screen applications such as vi and Multiplan.

Programming tools

Of course, there are many Unix tools available to the programming staff. All local programs are written in the C programming language or the Unix command interpreter language known as the shell language. Most C programs are written to be full-screen-oriented using the "curses" library of terminal cursor movement facilities.

The "terminfo" library of terminal capabilities and "escape sequences" allows the curses functions and, therefore, our local applications, to be terminal-independent.

The various releases of our major applications are maintained under the Unix source code control system, SCCS. Program debugging is accomplished using the symbolic debugger "sdb" and also by the use of a new C compiler called Safec, developed by Catalyst Corp. The debugger sdb provides monitoring of running programs and analysis of the core files produced by software asserts. Safec provides runtime checks on array subscripting, pointer validity and function activation lists.

The Unix "cscope" command provides cross-referencing of all C variable names with their uses in a program and is valuable during major program modifications.

System administration tools available under standard Unix and used by Commercial Union Capital Corp. include the "acct" accounting package for monitoring of system usage by account, port number and command name. Also, the system activity package "ia" provides very detailed CPU and disk usage for fine-tuning Unix.

Experience has shown us that the best way to use the Unix operating system is to avoid modifying it. Having the Unix source code available on-line is a temptation to clever programmers. However, part of the beauty of the native Unix releases is that they don't require system programmers to modify or maintain them. Unix allows the programming staff to spend its time writing applications and harnessing the power of the available tools to facilitate the company's business.

TTL Exploring The Creative Spectrum.

People. Technology. Environment. At Transaction Technology Inc., the combination of these fundamental elements—like primary colors—produces an unlimited array of creative opportunities for today's outstanding professionals.

TTL, a research and development subsidiary of Citicorp, is a recognized leader in the electronic banking field. To help maintain our position as a developer of innovative banking systems, we're looking for innovative engineers and professionals who are ready to enhance their creative horizons.

We have immediate needs for Systems and Applications Programmers with experience in UNIX® and C for the following areas:

- Advanced intelligent terminal systems development
- Communications-networking, protocols, local area networks, network control
- Personal computer software within a network environment
- Operating systems support
- Microprocessor application development

At TTL, we've established a stimulating and satisfying environment where people can fully develop their talents, along with our technology. If you would like to know more about the people, technology and environment that create a complete spectrum of career opportunities, take the initiative to send your resume and salary history to TTL today.

An Equal Opportunity Employer M/F/H.

TTI TRANSACTION TECHNOLOGY INC.

Department 884VC
3100 Ocean Park Blvd.
Santa Monica, CA 90405

A subsidiary of CITICORP®

*Trademark of AT&T Bell Laboratories

hundreds of different desktop asynchronous terminals.

Different terminal characteristics may be added in a matter of a few minutes as new terminals are acquired.

The IGP will provide the user with very powerful connect routines, which can be programmed to log on the user at the designated host. These routines are password protected, of course, but do give a user the freedom to extract information from a variety of systems without having to know the ID and password for each of them. Permission for access to these systems is granted by the system administrator and coordinated with the default administrator of the other systems.

Connected by the Defense Data Network, these IGPs will be located around the country at each of our Air

User communities will have the ability to tailor their own gateway processors to their unique applications.

Logistics Centers (ALC) and will each serve hundreds of logistics managers, most of whom have primarily worked from large listings of logistics data to do their job. With the advent of distributed on-line systems, AFLC is again becoming a major force in state-of-the-art technology, but with any number of decisions, the user needs need on-line, friendly assistance to take advantage of this new capability. The IGPs will provide this assistance, helping users to access a

variety of data from a variety of systems.

In addition, these IGPs will be functionally tailored to that user community such that a maintenance organization may have software tools specifically designed for maintenance functions, and a budget organization could have a completely different set of tools for its particular needs.

These tools include time/management packages, electronic spread-

sheets, personal calendar programs and graphics packages. Individual user communities will have the ability to tailor their own IGPs to their unique applications using the wide variety of programming tools available with Unix such as C language, Fortran, Pascal and others.

The IGP also provides, therefore, an Office Information System (OIS) for each user community in addition to the powerful connectivity capability. With this approach, AFLC can save many millions of dollars over the next few years by avoiding the pitfalls of acquiring a variety of vendor proprietary software for office automation applications, thus interfacing with the other. The IGP software (basically Berkeley 4.2 with Livermore Labs enhancements) is the foundation for a variety of OIS applications and will be the thread that ties all of AFLC's information systems together.

Why Unix? In our search for a portable operating system to provide command, control and communications capability for the European Distribution System (a Federal Ex-

UNIX* APPLICATIONS: DIRECTIONS '85

The UNIX Applications Forum
November 28-30, Century Plaza Hotel, Los Angeles

a partial selection of speakers:

John Rowley
Digital Research
David Ferrie
Ferrin Corporation
Aaron Goldberg
International Data Corp.
Alan Peller
AII Data Graphics/ISSCO
Adrian King
MicroSoft
Nicholas Nierenberg
Unify Corp.
Gary Morgenthaler
Relational Technology
Irene Nesbit
Nesbit Systems
Bruce Weiner
Digital Research
Donald O'Shea
Amdahl Corp.
William Joy
Sun Microsystems, Inc.
Daniel Lankford
AT&T Technologies
Karen Kauppinen
Handle Corporation

Esther Dyson
EDventure Holdings, Inc.
John White
Interactive Systems
Andrew M. Seybold
Seybold Organization
Ann Winblad
Open Systems
Bob Whitecotton
AT&T Information Systems
Joseph Alsop
Data Languages
Larry Dierz
The Alec Group
Mike Azzara
Computer System News
Pat Zivitz
Perkin-Elmer
Robert Marsh
Plexus Computers
Ron Conway
Altos Computers
Gill Steel
Digital Equipment Corp.
Bruce Milne
Accountants Microsystems, Inc.

If you are a computer or software vendor, distributor, publisher, reseller, or investor, this forum will show you the opportunities and pitfalls in the UNIX applications markets.

Demonstration Area featuring exciting innovative new application software from small, never seen before firms and larger established firms. Partial demonstration list: Appix, Inc., Interleaf, Inc., MAI-Basic Fous, Pyramid Technology Corporation, Quadrature.

TATES VENTURES 3350 West Bayshore Rd., Suite 201, Palo Alto, CA 94303

For more information call: 415-424-8844

*UNIX is a trademark of Bell Laboratories

The amount of data created for our managers will be awesome.

press type of concern for our air forces (and Energy), we discovered that Livermore Labs' Technology Information System Office had already developed many of the connectivity features for which we were searching. As Livermore Labs is a government-owned and contractor-operated facility, the software is available to certain government organizations, provided they have the proper Unix license from Bell Labs and Berkeley and a contract with the Department of Energy for Livermore Labs support.

The director of the program office responsible for the European Distribution System made the decision to adopt the Livermore Unix-based operating system. Its communications features and powerful electronic mail capability matched the needs. From this beginning, the Livermore/AFLC relationship developed, and the IGP was born.

The Air Force Logistics Command will modernize or create hundreds of information systems over the next 10 years, and the amount of data created for our managers will be awesome. The IGP will give these managers the necessary help in locating and connecting to the information required for AFLC to support the Air Force mission.

UNIX Joint Set Foster & Explorer

1. The UNIX Joint Set is a standard product available at the standard UNIX prices. It includes all of the UNIX utilities, C, Toolkit, shell programs and UNIX source code.

2. The UNIX System Manager Guide. The indispensable problem-solver for all UNIX users.

Available as a source license and can be customized to your needs.

O'Reilly & Associates
Specialists in Technical Communications
151 Jackson St.
Newton, MA 02159
(617) 237-4210

JACK SCANLON: THE GODFATHER OF AT&T's UNIX

BY STEPHEN HARRIS

PHOTOGRAPH BY JEFFREY M. STONE

APRIL 1990

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

48

49

50

51

52

53

54

55

56

57

58

59

60

61

62

63

64

65

66

67

68

69

70

71

72

73

74

75

76

77

78

79

80

81

82

83

84

85

86

87

88

89

90

91

92

93

94

95

96

97

98

99

100

101

102

103

104

105

106

107

108

109

110

111

112

113

114

115

116

117

118

119

120

121

122

123

124

125

126

127

128

129

130

131

132

133

134

135

136

137

138

139

140

141

142

143

144

145

146

147

148

149

150

151

152

153

154

155

156

157

158

159

160

161

162

163

164

165

166

167

168

169

170

171

172

173

174

175

176

177

178

179

180

181

182

183

184

185

186

187

188

189

190

191

192

193

194

195

196

197

198

199

200

201

202

203

204

205

206

207

208

209

210

211

212

213

214

215

216

217

218

219

220

221

222

223

224

225

226

227

228

229

230

231

232

233

234

235

237

239

241

243

245

247

249

251

253

255

257

259

261

263

265

267

269

271

273

275

277

279

281

283

285

287

289

291

293

295

297

299

301

303

305

307

309

311

313

315

317

319

321

323

325

327

329

331

333

335

337

339

341

343

345

347

349

351

353

355

357

359

361

363

365

367

369

371

373

375

377

379

381

383

385

387

389

391

393

395

397

399

401

403

405

407

409

411

413

415

417

419

421

423

425

427

429

431

433

435

major upgrades. While I would not like to commit to announcements on any particular date, you can expect us to announce both types of releases over the next 18 months.

Is it possible to order a machine based on the Unix operating system, read a short introductory manual, then turn it on and begin using it?

Our strategy thus far has been to look to our value-added reseller (VAR) customers to adopt the software to the specific needs of their customer base. To the extent their customers desire simplified administration and documentation procedures, then we would expect VARs to provide them. As time goes on, we will directly respond to this desire if the marketplace wants us to.

Portability is an important attribute of Unix in theory. Is that portability lost in reality where there are so many different versions of the operating system?

We agree that there is a need for a Unix system standard to assure users their investment in applications software is protected. That is why we, in response to user demands, have established System V as the standard.

Unix uses up too much memory. It's too powerful and simply inappropriate for the single-user micro environment. For optimum operation, the multitasking capability requires a 32-bit microprocessor and 32ME RAM — horsepower far beyond the typical desktop.

It is true that most instances of the Unix system deployed today require more memory and horsepower than available in the majority of desktop computers. However, as silicon technology advances, the power of the desktop computer will increase, allowing more and more of the strength of the Unix system to be capitalized on.

Coming at it from the other direction, AT&T is committed to unbundling the Unix system so as to provide our customers greater flexibility in packaging the system to meet their needs best. I think you will see these two trends coming together very nicely as workstations based on the next generation of 32-bit chips reach the marketplace in substantial quantities beginning in 1986.

System V was supposedly frozen, yet it was supplanted by Release 2 just one year later to fix bugs and upgrade. Do Unix's sheer size and complexity hinder widespread acceptance?

Unix System V Release 2.0, providing new functionality and performance improvements over Release 1.0, was issued as a fully upward-compatible release to Release 1.0. Our Unix system commitment is to maintain functionality and code compatibility from release to release while continuing to add new features and capabilities. Hence, our commitment to a standard is not intended to imply stagnation. With the technology evolving as rapidly as it is, a truly "frozen" operating system would fail to bring the user the potential afforded by new technology.

Even with the upgrades incorporated into Release 2, System V does not include features such as record

and file locking, which are considered necessary for a commercial environment, particularly in remote or distributed computing systems. Does AT&T plan to offer these?

Our original user base was program development and engineering people supported by minicomputers executing the Unix system. In the mid-1970s, we began to see demand that user base be developing within AT&T a number of turnkey systems on top of the Unix operating system to support business applications in the former Bell operating companies.

Shortly thereafter, Unix system VARs began to do the same and provide systems to meet the needs of their commercial customers. Many of those system providers developed extensions such as record locking to the

Unix system to allow their offerings to meet the needs of their customer base. Over time, many of these features have been incorporated into our standard implementation.

You can expect this trend to continue — that is, we will continue to incorporate into the Unix system those features needed by our customers. For example, we expect to be offering record locking and demand paging features later this year. The power of the Unix system and our commitment to an open architecture is that it allows this to happen — that is, new technology can be developed by many different groups and the most successful and important elements of this new technology can be incorporated into our evolving standard implementation. There will always exist unsatisfied needs and new capabilities in extensions devel-

oped by others; we are committed to respond to these in a way that serves our customer base with quality and consistency.

How does the Unix system fit into AT&T's view of networking?

AT&T's networking approach for its computer, communications and Unix systems is to create a simple open network architecture and endorse the international and de facto communications protocols.

A strategic thrust of our Unix system plan for the next few years will be to provide fundamental networking capabilities in a way that facilitates communications at all protocol levels between all vendor machines executing Unix System V. We believe this capability is essential to meet

"Intelligence...is the artificial objects, especia

This quote appeared in a 1978 issue of *The Bell System Technical Journal* that was devoted to a series of papers constituting the first complete description of the UNIX™ operating system.

At that time, Unix was used primarily by sophisticated programmers.

No longer. INTERACTIVE now offers UNIX software tools for every computer user: executives, engineers, office workers, and our oldest customers — those sophisticated programmers who have built UNIX into a major new force in the computer industry.

Here's how we built our enhanced version of UNIX.

First, we simplified the user's interface to UNIX.

Most UNIX systems require all their users to learn a large set of powerful but cryptic commands. We don't. We give our users the option of performing most tasks with the ten basic commands shown in the illustration.

We also make available a larger set of commands for the experienced user and the full set of commands for the UNIX expert.

Then, we lowered the cost of using UNIX.

We've improved the efficiency of UNIX. And we shifted some of the workload from the



the needs of the office environment, which is becoming more and more heterogeneous in the way of computing devices.

The inherent strength of the Unix system architecture coupled with AT&T's overall communications expertise will, in my opinion, allow us to make very strong contributions in this area. This market need will mandate open communications architectures, and we are committed to delivering them.

Much of the discussion about Unix centers on its merits as an operating system and its advantages to programmers. What specific benefits do you see in a typical corporate environment?

Almost all applications today have an element of multiuser access. While

Once the user investment in applications is insulated from hardware, the customer will be king, able to select the best hardware at the lowest price to meet his need.

we do not expect these applications to be replaced overnight, we will see a trend toward using the Unix operating system for new applications.

In fact, there is one area that is ideally suited for both the "newer" and "older" modeling aspects of the Unix operating system, and that is in office automation.

Are you planning to offer a product in office automation?

Office automation products based on the Unix operating system are already in wide use inside AT&T. As a statement of direction, we have indicated that our strategic software and system products will be based on

faculty of making lly tools to make tools."

—Henri Bergson (1859-1941)

central processor to intelligent terminals. You can use our intelligent terminal or the IBM® Personal Computer to perform tasks normally assigned to a UNIX central processor.

Next, we adapted our software to new systems.

We started with our IS/3 system running on DEC® PDP® and VAX® computers. And we refined our major tools so that they run as an extension to DEC's VMS™ operating system.

Recently, we adapted the entire IS/3 for the IBM Personal Computer. That product is now available from IBM. We have also completed a port of IS/3 to the SCI 1000, a multi-user system sold by SCI Systems.

Now, we're adding the applications needed in corporations and other large organizations.

"We are already delivering an electronic mail system and a very sophisticated networking system. Our users can exchange files, share central resources such as laser printers, or send mail anywhere in a network. We are also delivering FORTRAN compilers, C

compilers and cross-compilers, and a powerful system for preparing memos, manuals, and other documents. We even have an option that allows you to send or receive mail through the TWX and Telex networks.

We'll be announcing new applications soon. We are building a library of software tools that will help you build a system matched to the needs of your organization. We're also working on new ports that will let you run the system on other computers in your company.

To receive our free brochure, "How to choose a UNIX supplier," contact:
INTERACTIVE Systems Corporation
1212 Seventh Street
Santa Monica, CA 90401
(213) 450-8363.
TWX: 910-343-6255. Telex: 18-2030

INTERACTIVE
SYSTEMS CORPORATION

UNIX is a trademark of AT&T Bell Laboratories.
PDP, VAX, and VMS are trademarks of Digital Equipment Corporation.
SCI is a registered trademark of International Business Machines Corporation.

Unix System V.

Steve Mosher, director of data systems marketing for AT&T Information Systems, has said about the Unix operating system and AT&T, "...as the inventor of the product, we believe that it is the most important. Microsoft Corp.'s Xenix, Berkeley 4.3 and others, can you say that System V is the best in the marketplace now or that an AT&T version ever will be?"

Depending upon the particular needs of a customer, it is possible at any given time that versions of the Unix system other than System V might better meet a specific need. In general, in those cases where other versions meet an important customer need, you can expect us to see to it that our standard Unix system will be enhanced and will meet that need.

At the National Computer Conference in July, you said, "Our plan with customers is to follow the Unix system. We plan to move Unix down to micros and up to mainframes." Does that imply that AT&T will be coming out with a mainframe in the foreseeable future?

AT&T is always investigating and assessing various business opportunities. However, you should not construe my statement as an indication that AT&T will or will not be in the mainframe business in the foreseeable future.

If your plan is to take Unix down to micros, why did AT&T announce a personal computer based on MS-DOS?

As a first step, AT&T announced its MS-DOS-based personal computer, recognizing the widely available and popular application software written for this operating system. In the interest of protecting customers' investments, our AT&T PC Interface allows Unix System V communications with systems utilizing MS-DOS version 2.0 without users' having to learn any new interface. This will bring the power of Unix systems to the existing MS-DOS base of users. In the future, AT&T will be offering additional enhancements that will allow customers to make a smooth transition from their current systems to systems based on Unix software.

How necessary is it to the success of Unix for IBM to give it more of an endorsement than just running it on its Personal Computer?

The Unix system has become popular over the past 10 years because of the many key features (portability, multiuser operations, background processing, file system, the shell, pipes, utilities and so on) that customers find attractive.

Because of the demands of the marketplace, most of the world's major computer companies are now licensed from us. Any computer vendor that makes a commitment to the Unix system is making a business decision to further its own interest — and, in our judgment, a pretty good one.

When you say that Unix can free users from "hardware tyranny" because it is portable, aren't you directly challenging IBM?

Unix will challenge the capability

of all hardware manufacturers, including AT&T. Once the user investment in applications is insulated from hardware (any make or generation of hardware), the customer will be king, then being able to select the best hardware at the lowest price to meet his need. All hardware vendors will have to deal with the new levels of customer freedom.

AT&T is coming late to computer marketing, but your late start allows you to design a product line that is compatible from top to bottom, based on Unix. With so many products released over as many years to fit as many purposes, IBM is not in such a position. Is this AT&T's competitive edge?

There are more negatives than positives coming to the commercial computer marketplace "late," as you put it. But we were operating under a consent decree that required us from beta to in this business commercially. However, we have been designing and building computers for the world's largest telecommunications networks for more than 20 years.

Specifically, however, we have introduced a new product line of AT&T 3B computers with an open architecture that facilitates interfacing with our large existing installed base of computers. Also, this product line has the advantage of a common operating system — Unix System V — and advanced communications capabilities (that is, PC Interface, AT&T SNet, AT&T Information System Network [ISDN] and AT&T strength and heritage).

Also, we are a resourceful company with a wealth of talented people. AT&T is at the forefront of advances, like the transistor and coding theory, set the technical foundations of the computer industry. It is great to be able now to complete products rather than just our technology.

AT&T's hands-off attitude toward Unix in the early years actually encouraged university students to experiment with the operating system and take their experience with them into business. But now AT&T has its hands on the marketing. What is the overall strategy to convince systems managers to turn to Unix — for instance, as an operating system that can solve the micro-mainframe link problem?

All of my comments to your last networking question apply here as well. In addition, the Unix system today executes on all size computers from small to very large.

This flexibility is conducive to native or "transparent" communications and sharing of resources, a cru-

cial reason for wanting to link workstations to mainframes. By providing application programs a standard environment for a wide variety of machine types and powerful networking capabilities, the next step in office automation can be taken.

And by providing the architecture and tools to allow interconnection with computers that are not running Unix, a fully integrated environment can be achieved.

Isn't it ironic that the operating systems that AT&T ignored for so long is now the centerpiece of its computer strategy?

AT&T never ignored the Unix system. In fact, it has been used widely within the company including many of our switching and operations support systems products.

For a long time, the consent decree prevented us from doing more with the Unix system.

In July, AT&T and Olivetti announced Unix Europe, described as a joint venture company to promote System V. What will Unix Europe do for customers?

Unix Europe is a London-based joint AT&T-Olivetti venture created to service and expand the market for Unix System V in Western Europe.

Its activities will include:

- Licensing the use of

source code of Unix System V operating system and related software.

- High-level technical support.

- Specialized training.

- Running the European operations of the Unix System V Library of Applications Software. (This library has been active in the U.S. since February 1983.)

It will provide AT&T European customers with faster service and shorter turnaround time.



In addition, on July 18, 1984, we also announced our Unix Systems Far East office, which will be resident in Tokyo and perform many of the same functions for the Far East as Unix Europe.

Is Unix spreading as fast outside the U.S. as inside?

The Unix system movement outside the U.S. is just taking hold, and thus we are seeing stronger growth rates from our international business-

ing activity. At work at the AT&T International installed base of Unix systems, we see the following breakdown: 73% North America, 17% Europe, 9% Far East and 1% "other." However, the growth rates since early 1983 invert this order: 65% Far East, 55% Europe and 30% North America.

Hence, while the Unix system's growth rate in North America is certainly a healthy one, Europe and the

Far East are growing at about twice the North American rate. The formation of Unix Europe and Unix Far East offices will better serve our international customers and amplify the further commercialization of the Unix system.

Here are a few dimensions of the present scope of this commercialization:

About 90,000 computers of approximately 125 different models from 80 different computer companies now run

Unix operating systems. The total number of installations is expected to increase by a factor of anywhere from two to six during 1984.

About 300 application packages are now available from more than 90 software companies, up by a factor of six over what was available in 1982. These include 50 accounting packages, 25 word processing packages, 15 graphics packages and 13 spreadsheets.

Vertical packages, such as

medical/dental, legal, manufacturing and real estate, also are starting to emerge.

It is estimated that about 100,000 programmers are now writing Unix operating systems software. Independent market analysts predict total Unix operating system business (software, hardware and support) to increase by about a factor of four by 1986 from a dollar value of about \$1.8 billion in 1982. Total revenues of more than \$8 billion in 1986. And this is only the beginning.

We've discussed many of Unix's problems and challenges in the future. Tell me what is so good right now, about the operating system, particularly in comparison with others available?

The strengths are many, varied and deep and getting known to more and more people. Its portability across a wide variety of machine architectures and vendor products has been proven and time again and continues to demonstrate the feasibility of achieving a standard having little dependency on the underlying hardware.

This leads to its second, and in my opinion most important, strength: application software portability. That is, software written to a Unix system can be moved from vendor A's computer model M to vendor B's computer model N with relatively little effort — something virtually unheard of in the industry up to now. This gives users the opportunity to protect their ever-growing investment in application software while continuing to take advantage of the best hardware price/performance the technology will support.

The ramifications to the industry could be dramatic, making the Unix operating system, from the standpoint of its impact on the industry, much more than just another operating system.

The third strength of the Unix system's open architecture relative to the networking needs of the industry has been discussed.

Finally, the classical strengths such as the inherent multitasking and multitasking capabilities, pipes (which allow you to coordinate and link together the inputs and outputs of individual programs), file system, text processing and powerful productivity tools, to name but a few, continue to make it well suited to the needs of people accomplishing their day-to-day tasks.

Although many other operating systems have some features the Unix system does not have today, in my opinion none has the overall scope, flexibility and depth of Unix System V. I believe it is the leader today in terms of overall capability, and we are committed to keeping it there in the future.

**If you're reading someone
else's Computerworld,
cut it out.**



Yes Please send me Computerworld for one year at \$39 (that's \$5 off the annual subscription rate of \$44). I understand that my satisfaction is guaranteed and that I may cancel at any time and request a refund on the unused portion of my subscription.

Subscription Form

First Initial	Middle Initial	Last Name
Year Born		
Company Name		
Address		
City	State	Zip Code

If you are using a credit card, you can enter your order by calling TOLL-FREE: 1-800-343-5730!

(In Massachusetts, call collect: 617-879-0700.)

Address shown is: Home Business

Check here if you do not wish to receive promotional mail.
Please indicate your business, title, and computer involvement
below. Circle one number in Categories 1 and 2 and all that apply
in Category 3.

1. BUSINESS/INDUSTRY

End Users

- 10. Manufacturer (other than computer)
 - 20. Finance/Insurance/Real Estate
 - 30. Medicine/Law/Education
 - 40. Wholesale/Retail/Trade
 - 50. Business Service (except DR)
 - 60. Government — State/Federal/Local
 - 65. Public Utility/Communication Systems/Transportation
 - 70. Mining/Construction/Petroleum/Refining

© 2000 Smith

1000

- 80. Manufacturer of Computers, Computer-Related Systems or Peripherals**
85. Computer Service Bureau/Software/Planning/Consulting
90. Computer/Peripheral Dealer/Distributor/Retailer
95. Other Vendor _____

(Please Specify)

- Bill me.
- Payment enclosed.
- Charge to my credit card.
- AmEx BA/VISA MC

SAC-But-Anti-Social-Groups (see your name)

(MC Only-List 10)

EXPLORERS

Signature:

2. OCCUPATION/FUNCTION

- 11. President/Owner/Partner/General Manager
 - 12. VP/Administrative VP
 - 13. Treasurer/Controller/Financial Officer
 - 21. Director/Manager/Supervisor DP/MIS Services
 - 22. Director/Manager of Operations/Planning/Admin. Serv.
 - 23. Systems Manager/Systems Analyst
 - 31. Manager/Supervisor/Programming
 - 32. Programmer/Methods Analyst
 - 35. QA/WP Director/Manager/Supervisor
 - 36. Data Comm., Network, Systems Mgmt.
 - 41. Engineer/Scientific/R&D/Technical Mgmt.
 - 51. Manufacturing Sales Reps./Sales/Marketing Mgmt.
 - 80. Consulting Services
 - 70. Medical/Legal/Accounting/Management
 - 80. Educator/Journalist/Librarian/Student
 - 90. Other

(Please specify)

3. COMPUTER INVOLVEMENT

Types of equipment with which you are personally involved either as a user, vendor or consultant (circle all that apply).

- A. Mainframes/Supernovas
 - B. Minicomputers/Small Business Computers
 - C. Microcomputers/Desktops
 - D. Communications Systems
 - E. Office Automation Systems

Satisfaction Guaranteed On Paid Subscription:

I understand that I may cancel my subscription at any time (discontinuing the bonus issues), and request a full refund of the unused portion of my subscription.

Fill in and return to: 375 Cochituate Road, Box 897, Framingham, MA 01701

COMPUTERWORLD

THE NEWSWEEKLY FOR THE COMPUTER COMMUNITY

UNIX's INFANCY

W

EVOLUTION OF UNIX SYSTEMS		
Year	Internal releases	External releases
1972	Version 2	
1973	Version 3	
	Version 4	Unix V4
1974	Version 5	
1975	Version 6	Unix V6
1976	Programmer's Workbench (PWB)	PWB/Unix
1977	Version 7	Unix V7
1978	32V	Unix 32V
1979	PWB 2.0	
1980	Release 3.0	Unix System III
1981	Release 4.0	
1982	Release 5.0	
1983 (Jan.)		Unix System V*
1984 (Jan.)	Unix System V (Release 2.0)	Unix System V (Release 2.0)
1984 (May)	Unix System V/M68000	Unix System V/M68000**

* The first commercial version to be supported by AT&T.

** A port of Unix System V to the Motorola 68000 microprocessor — developed by Motorola, Inc. for AT&T.

never stopped. As Ritchie has stated, "What we wanted to preserve was not just a good environment in which to do programming, but a system around which a fellowship could form."

Thompson and Ritchie's initial attempt to develop an operating system began with a rewrite on the Digital Equipment Corp. PDP-7 of a game called Space Travel, first written on Multics. During this rewrite, the ground was laid for developing a common interpreter (shell).

In 1970, Unix was named — a takeoff on Multics. By whom? Brian Kernighan.

The next development was the writing of process control routines or system calls. DEC had just introduced the PDP-11, and Thompson and Ritchie decided that it was a better machine for their development

work. The orders not to develop an operating system still stood. To get around this problem, they proposed to build a compiler and accompanying text for the patent department. And the "roll" text formatter was born, along with the first application to be offered on Unix.

Work continued in the early 1970s. All processes were initially written in assembly language. The first language to be developed for Unix was Thompson's B language, intended to be a Fortran compiler. This language was the forerunner for C, which Ritchie developed in 1971.

In 1973, the C language and filters were introduced. In 1975, the Unix operating system kernel was rewritten in C.

One of the advantages of using a language that did not depend on specific machine language or assembly language was the ability to port the operating system to other hardware. This feature was understood early in the development of Unix. The goal was to make the kernel as machine-independent as possible and to isolate the machine-dependent portions to be changed.

Asked about the evolution of Unix into a product, Ritchie said, "Our efforts involved a lot of teamwork. Unix attracted many users within the Lab whose work developing applications contributed ideas to improve and expand the capabilities."

Bud Wosniakiewicz, an initial user of Unix at Bell Labs, said, "The experience was frustrating, but not in an unpleasant way. The experience was around the help. It involved a lot of learning by trying things. An experimentalist likes to learn this way."

Ritchie and Thompson never intended to build a product to sell. When asked what had surprised him most about the success of Unix, Ritchie said, "The acceptance and usage of Unix is a lot larger than I expected. We expected the technical ideas to have an influence in the development of operating systems. What happened was really an acceptance of the technical idea, but Unix itself was accepted."

Ritchie and Thompson received the 1982 Electronics Achievement Award — the first time in its nine-year history the award was given for software. And they received the 1983 Association for Computing Machinery Turing Award and the new Software System Award for their development of generic operating systems theory and the Unix operating system specifically.

Reaching a product

By the Justice Department's 1966 Consent Decree, AT&T was forbidden to engage in certain nonregulated activities. The company took a conservative position. To avoid being in the software business, it licensed the Unix software but did not support it. Thus in the early 1970s, when universities began adding Unix to the Unix operating system, Version 5 was made available. It was offered as is — no technical support, no warranties, no patent indemnification, no support or service, no maintenance and payment in advance.

The product was first licensed in 1973. Seventeen licenses were issued to universities, the first to the California Institute of Technology.

In 1974, the first commercial license (and first international) was granted to the Santa Cruz Operation. The system's portability sparked commercial interest and, in 1975, the first com-

THE FAST TRACK

Is CAD really THE FAST TRACK for your career?

It depends on the company.

You could work in CAD systems at a lot of fast-moving microelectronics companies. But only one is the fastest-growing major integrated circuits company in the world. Only one is committing a significant portion of its rising profits to the large-scale, on-going development of a corporate CAD network.

Advanced Micro Devices is the fast track. In Q3B, with fiscal 1984 sales up 62% to over \$2.63 million and projections to pass the \$1 billion mark in fiscal 1985, AMD has the resources to support CAD development. We're using IBM 30XX mainframes, VM/UNIX and a network of specialized processors to support state-of-the-art CAD workstations for IC design. And we're investing in the future of CAD by supporting UC Berkeley's CAD/CAM consortium.

Corporate CAD Systems

■ Department Managers/Engineering Data Center

Manage a group providing systems programming, capacity planning, resource and performance tuning to support AMD's CAE needs. BSEE/CS with experience managing VME systems programming on IBM 30XX computers.

■ VM System Programmers

BS or equivalent experience and 2-3 years as VM systems programmer, with at least 1 year independently installing software packages.

■ UNIX Systems Programmers

BS or equivalent experience with 3 years installing and maintaining UNIX operating systems. 16M port CAD applications software between engineering workstations and IBM processors.

Find out how good you really are. Get on the fast track at the forefront of IC design methodology of the future at AMD.

Call Ed Lake TOLL FREE at (800) 538-8486, ext. 5555. Or send your resume to Advanced Micro Devices, Dept. CY, 2000 19th Street, MS-57, Sunnyvale, California 94085. P.O. Box 3463, Sunnyvale, California 94088. An equal opportunity employer. Principals only, please.



The fast track in CAD.

cENGLISH™.. The C Generation Language

What is cENGLISH?

cENGLISH is a fourth generation procedural language based on dBASE II™ syntax. It is portable to a wide range of micros and minis. The language features user-transparent interfaces to a variety of C compilers, operating systems, and database managers.

How does cENGLISH work?

cENGLISH achieves portability through a compiler interface which translates cENGLISH into documented C source and uses a host C compiler to produce native machine code.



This means you can develop applications on one system that will run, without modification, on a wide range of machines. The example program on this page will run on any system that uses cENGLISH.

Call for availability of cENGLISH for the following configurations—

Compilers:
Standard C/S compilers: Lattice C™ for MS-DOS™

Operating Systems:
UNIX™, UNIX-like, MS-DOS™, Coherent™, VMS™

Data Base Managers:
C-ISAM™ and INFORMIX™, UNIFY™, ORACLE™, PHACT™,
Logix™

Foreign Language Versions:
German, French, Spanish

ATTENTION MICRO USERS!

Demo version and special introductory offer available for IBM PC XT™ and AT™.

Call for availability of other single-user versions and dBASE II™ and dBASE III™ to cENGLISH Converters.

Requirements: 256K, hard disk, MS-DOS 2.1 or higher.

Call or write:

C LINE

Tech., 80 West Ontario, Chicago, IL 60610 • (312) 944-4810

In Canada: cLINE Canada, Inc. - Complexe Le Laurentienne • 425, St-Ambroise, Québec J0A 1E0
Quebec, Canada G1R 2B4 • (416) 924-4841

Sample cENGLISH Program

IDENTIFICATIONS

MODULE: Minname

AUTHOR: bcs

DATE: 8/29/84

REMARKS: Sample cENGLISH program that adds first names to a file

END IDENTIFICATIONS

GLOBS

FIXED LENGTH 1 ans

FIXED LENGTH 15 Frame

END GLOBS

MAIN PROGRAM

BEGIN

CLEAR SCREEN

SET ECHO OFF

USE "NAMES"

VIEW BY "ID...NAME" ASCENDING

AT 23,1 SAY "Add a record? Y or N"

AT 23,25 ENTER ans USING "!"

WHILE ans EQ "Y"

CLEAR GETS

AT 6,1 SAY "Enter first name"

AT 6,20 GET Name

USING "....."

READ SCREEN

INSERT

Name = Name

END INSERT

AT 12,10 SAY "Welcome to cEnglish. " & Name

WAIT

" TO Frame

STORE * " TO ans

AT 23,1 SAY "Add another record? Y or N"

AT 23,30 ENTER ans USING "!"

CLEAR ROW 1 THRU 23

END WHILE

AT 12,10 SAY "That's all for now!"

UNUSE "NAMES"

SET ECHO ON

END PROGRAM

Major credit cards accepted.

UNIX SYSTEM V PRODUCT FAMILY					
DEC Processors	AT&T Processors	Motorola M68000	Intel Microprocessors	Zilog Microprocessors	National Semiconductor Microprocessors
VAX-11/750	3820S	Exarmex			
VAX-11/780	3820A	VAX-11/780*			
PDP-11/70	385	AT&T 3820S*			
	382				

* Initial purchase of one of the above sources is \$43,000. Additional source licenses for other packages in the family are \$16,000.
 • Each package includes the right to utilize that source on one designated CPU.
 • Additional designated CPUs for licensed packages may be obtained for \$16,000 each.
 • Licenses having a source license for one additional package and sublicense rights may designate additional source CPUs on the following schedule:

1-32 user system	\$1,000	Current	Future
1-64 user system	\$3,500		
>64 user system	\$7,000		

*Development systems

mercial vendor was issued a license, along with royalty schedules and distributor provisions for sublicensing. That vendor was Yourdon, Inc.

Other milestones were the introduction in 1980 of Unix on 16-bit microcomputers by Onyx Systems, Inc.; the porting of Unix to Amdahl Corp.'s 470 series in 1981; and, in the same year, Microsoft Corp.'s Xenix port to the Tandy Corp. Model 16. Now Unix is an hardware from mid-range mainframes.

While the antitrust suit was in progress, AT&T was allowed to assume a larger role in marketing computers and related products. In November 1981, the Justice Department and AT&T announced a settlement that removed many of the 1966 Consent Decree restrictions. Licensing was moved from Western Electric to AT&T. In 1980, AT&T announced Unix System III, the first step in regaining Unix's market share.

At the January 1983 Unix, System V and support were announced. Four months later at the National Computer Conference, AT&T announced that licenses were available for Unix on three microprocessors — the Motorola, Inc. 68000, Intel Corp. iAPX286 and National Semiconductor Corp. 16032. At the July 1983 Usenix conference, AT&T announced supported software packages: Instructional Workbench, Unix Tutorial and Writers Workbench, an aid for

technical writers.

Then on Jan. 15 of this year, IBM confirmed rumors by announcing the availability of Unix on its Personal Computer. When asked whether he felt that Unix needed IBM's stamp of approval to be legitimate, Dennis Ritchie said, "As a technical accomplishment, Unix has always been legitimate. Maybe from a marketing viewpoint, IBM has to approve something for it to be legitimate in the consumer business. But I think that is a short-sighted viewpoint."

There are many other companies that believe in the legitimacy of Unix. Currently, 130 have licenses for and provisions to sublicense Unix V.

The growth in licenses and installations indicates that many believe the product is around to stay.

First followers

Clandestine development, lack of organized support and the seal of the original users all set the stage for a religious movement around this operating system.

Who were the first followers? Back in 1974, when the first few copies of Unix found their way into universities, a small group of programmers quickly became addicted. Some started to meet twice a year to exchange information about the operating system and the C language. Meetings at universities included Bell

Labs people and served as a forum for discussing changes and improvements.

Attendance grew from 20 to 200, and in 1980, the Usenix organization was born. Members exchange technical ideas. The group publishes newsletters six times a year and holds conferences twice a year. Headquartered

in El Cerrito, Calif., Usenix now claims more than 1,200 members.

While the technical people organized to exchange information, marketing people met to offer each other support in getting Unix off the ground as a product. About a dozen people, including Mike Florio, current president of /user/group, began meeting in 1980 to fill the marketing void. They wanted a forum for discussing ways to increase the system's use, to create a source for positive publicity and to add to a stable base from which a Unix market could grow.

Incorporated in July 1981, /user/group publishes a bimonthly newsletter and a catalog of Unix applications and related products. It holds yearly conferences, and membership has grown to about 2,000.

Unix has surpassed its developers' original goals — to provide a good development environment and to be as independent from hardware as possible.

Lee Sigler is a consultant in computer industries marketing with Technology Decisions, Inc. in Los Angeles, Calif.

ACCESS METHODS INCORPORATED Consultants to the UNIX® Industry

AMI: We are UNIX®

We have the most challenging and sought after consulting assignments in the industry:

- Kernel Work
- Distributed UNIX®
- Networks (x.25 and LAN's)
- Graphics
- Real-Time Systems
- Languages, Compilers, and Translators
- Hardware and Microcoding

If you are interested in learning more about consulting, see us at UNIX Expo, Booth 247, and visit with some of our top experts. Drop your business card in our fishbowl for a chance at a free Video Recorder.

*UNIX is a trademark of AT&T Bell Laboratories



AMI
ask for us
(201) 744-9126

UNIX® SPREADSHEET Q~CALC

As powerful as Lotus 1-2-3®

Fully integrated with Unix

Complete graphics capabilities
running on

Vaxen, Callan, Fortune, Sun, etc., etc.

call/write

Quality Software Products Inc.

365 S. CLARK DRIVE
BEVERLY HILLS, CALIFORNIA 90211
(213) 659-1566

Bell is a trademark of Bell Labs. Lotus 1-2-3 is a trademark of Lotus Corp.

Bit Slice Microprogram Development Facility Operates Under UNIX®

- bca.c: Variable word length assembler
- slice.c: Slices object file to PROM size files
- dataio.c: Transmits PROM files to DATA I/O PROM programmer
- stepify.c: Down loads object file to Step Engineering PROM emulator

Single CPU source code license \$5,000

*UNIX is a registered trademark of AT&T Bell Laboratories



Pacific Computer Sales, Inc.
100 South Cole Road
Boise, Idaho 83709
(208) 322-1112

IN THE BEGINNING . . .

(This article is adapted from "The Evolution of the Unix Time-Sharing System," by Dennis M. Ritchie, published in Lecture Notes in Computer Science, Vol. 79, Language Design and Programming Methodology, edited by Jeffrey M. Tobochnik, pages 35-35. Copyright © 1980 Springer-Verlag, Berlin Heidelberg-New York.)

The Unix computing system has come into wide use, so wide that its very name has become a trademark of Bell Laboratories. Its important characteristics have become known to many people. It has suffered much rewriting and tinkering since the first publication describing it in 1974, but few fundamental changes. However, Unix was born in 1969, not 1974, and the account of its development makes a little-known and perhaps interesting story.

For computer science at Bell Laboratories, the period 1968-1969 was somewhat unsettled. The main reason was the slow, though clearly inevitable, withdrawal of the Labs from the Multics project. To the Labs computing community as a whole, the problem was the increasing obviousness of the failure of Multics to deliver promptly any sort of usable system, let alone the panacea envisioned earlier.

For much of this time, the Murray Hill Computer Center was also running a costly General Electric Co. 645 machine that inadequately simulated the GE 635. Another shake-up that occurred during this period was the organizational separation of computing services and computing research.

From the point of view of the group that was to be most involved in the beginnings of Unix (K. Thompson, Ritchie, and D. McIlroy), the associated decline and fall of Multics had a directly felt effect. We were among the last Bell Laboratories holdouts actually working on Multics, so we still felt some sort of stake in its success. More important, the convenient interactive computing service that Multics had promised to the entire community was in fact available to our limited group, at first under the CTSS system used to develop Multics and later under Multics itself.

Even though Multics could not then support many users, it could support us, albeit at exorbitant cost. We didn't want to lose the pleasant niche we occupied, because no similar ones were available; even the time-sharing service that would later be offered under GE's operating system did not exist.

What we wanted to preserve was not just a good environment in which to do programming, but also a sense of community fellowship that could form. We knew from experience that the essence of communal computing, as supplied by remote-access, time-shared machines, is not just to type programs into a terminal instead of a teletype, but to encourage close communication.

Thus, during 1969, we began trying to find an alternative to Multics. The search took several forms. We (mainly Ossanna, Thompson, and Ritchie) lobbied intensively for the purchase of a medium-scale machine for which we planned to write the operating system; the machines we suggested were the Digital Equipment Corp. PDP-10 and the Sigma Data

Systems (later Xerox Corp.) Sigma 7. The effort was frustrating, because our proposals were never clearly and finally turned down but yet were certainly never accepted.

Several times it seemed to us that this effort came when we presented an extremely complex proposal, designed to minimize financial outlay, that involved some outright purchase, some third-party lease and a plan to turn in a DEC KA-10 processor on the soon-to-be-announced and more capable KI-10. The proposal was rejected, and rumor soon had it that W.O. Baker (then vice-president of research) had reacted to it with the comment, "Bell Laboratories just

doesn't do business this way!"

Actually, it is perfectly obvious in retrospect (and should have been at the time) that we were asking the Labs to spend too much money on too few people with too vague a plan. Moreover, I am quite sure that at that time operating systems were not, for our management, an attractive area in which to support work. They were in the process of extricating themselves not only from an operating system development effort that had failed, but from running the local Computation Center. Thus, it may have seemed that buying a machine such as we suggested might lead on the one hand to yet another Multics or, on the other, if we produced



Dennis Ritchie

UNIX & C

MANY UNIX-BASED SYSTEMS ONE UNIX TRAINING COMPANY

The Computer Technology Group provides the UNIX training solution. Training to fit the complexities of your UNIX-based system.

Three factors make the Computer Technology Group the experts in UNIX and C language training:

- Experience, through training thousands of students worldwide in live seminars, with thousands more using our video training at their own locations.
- Extensive Curricula Supporting All UNIX Versions, creating a client base of manufacturers, software developers and end users.
- Quality of Instruction, with instructors and course developers who are experts in teaching UNIX and C, as well as in designing and implementing a variety of UNIX-based systems.

ONE UNIX TRAINING COMPANY MULTIPLE DELIVERY SYSTEMS

Whether you're training two, 200, 2000...you can select the most efficient and economical training solution for your unique environment:

- Public Seminars offered in major cities throughout the world.
- On-Site Seminars for training customized to your system and to specific groups within your organization.
- Video-Based Training for consistent training that is always available at your location.
- Interactive Videotape Training, which dynamically tailors courses to the individual—from novice to expert programmer.

ASK FOR OUR 48-PAGE COURSE CATALOG, WHICH PROVIDES:

- Comprehensive course outlines
- Course prerequisites
- Curriculum recommendation for multiple audiences
- Guidelines for cost-effective training media selection
- Current seminar schedule

CALL (800) 323-0982 or
(312) 967-4062 in Illinois

* UNIX is a trademark of Bell Laboratories.

COMPUTER TECHNOLOGY GROUP

Telcomedia, Inc.

330 S. Michigan Ave., Chicago, IL 60604

something useful, to yet another Computation Center for them to be responsible for.

Besides the financial agitations that took place in 1969, there was technical work also. Thompson, R.H. Canaday and Ritchie developed, on blackboards and scribbled notes, the basic design of a file system that was later to become the heart of Unix. Most of the design was Thompson's, as was the impulse to think about file systems at all, but I believe I contributed the idea of device files.

Thompson's itch for creation of an operating system took several forms during this period; he also wrote (on Multics) a fairly detailed simulation of the performance of the proposed file system design and of paging behavior of programs. In addition, he started work on a new operating system for the GE-445, going as far as

writing an assembler for the machine and a rudimentary operating system and whose greatest achievement, so far as I remember, was to type a greeting message. The complexity of the machine was such that a mere message was a fairly notable accomplishment. But when it became clear that the lifetime of the 645 at the Labs was measured in months, the

Also during 1969, Thompson developed the game "Space Travel." Though it made a very attractive game, Space Travel served mainly as an introduction to the clumsy technology of preparing programs for the DFS-7. Soon Thompson began implementing the paper file system (perhaps "chall file system" would be more accurate) that had been designed earlier. A file system without way to exercise it is a sterile procedure.

sition, so he proceeded to flesh it out with the other requirements for a working operating system, in particular, the notion of processes. There came a small set of user-level utilities: the means to copy, print, delete, and edit files and, of course, a simple command interpreter (which)

Up to this time, all the programs were written using Gecos, and files were transferred to the PDP-7 on paper tape; but once an assembler was completed, the system was able to support itself. Although it was not until well into 1970 that Brian Kernighan suggested the name "Unix," in a somewhat treacherous pun on "Multics," the operating system was

The PDP-7 Unix file system

Structurally, the file system of PDP-7 Unix was nearly identical to

today's. It had an I-list, directories and special files describing devices.

discussed below, they were similar to what one finds now. A minor difference was that the unit of *I/O* was the word, not the byte, because the PDP-7 was a word-addressed machine. In practice, this meant merely that all programs dealing with character streams ignored null characters, because null was used to pad a file to an even number of characters. Another, minor, occasionally annoying difference was the lack of erase and kill processing for terminals. Terminals, in effect, were always in raw mode. Only a few programs (notably the shell and the editor) bothered to implement erase-kill processing.

In spite of its considerable similarity to the current file system, the PDP-7 file system was in one way remarkably different: There were no path names, and each filename argument to the system was a simple name (without "/") taken relative to the current directory. Links, in the usual Unix sense, did exist. Together with an elaborate set of conventions, they were the principal means by which the lack of path names became acceptable.

The most serious inconvenience of the implementation of the file system, aside from the lack of path names, was the difficulty of changing its configuration. As mentioned, directories and special files were both made only when the disk was re-created. Installation of a new device was very painful, because the code for devices was spread widely throughout the system. For example, there were several loops that visited each device in turn. Not surprisingly, there was no notion of mounting a removable disk pack, because the machine did not have a single fixed-head disk.

The operating system code that implemented this file system was a drastically simplified version of the present scheme. One important simplification followed from the fact that the system was not multiprogrammed. Only one program was in memory at a time, and control was passed between processes only when an explicit swap took place.

So, for example, there was an "i/o" routine that made a named l-node available, but it left the l-node in a constant, static location rather than returning a pointer, into a large table of active pointers. A pointer to a current buffer in a machine was passed (with about four buffers), but there was essentially no overlap of disk I/O with computation. This was avoided not merely for simplicity. The disk attached to the PDP-7 was fast for its time — it transferred one 18-bit word every two microseconds. On the other hand, the PDP-7 itself had a memory cycle time of one microsecond, and node initialization took two cycles (one for the instruction itself, one for the read and).

However, indirectly addressed instructions required three cycles, and indirection was quite common, because the machine had no index registers. Finally, the direct memory access controller was unable to access memory during an instruction. The upshot was that the disk would incur overrun errors if any indirectly addressed instructions were executed

Fast...Versatile ...Powerful Tools



Integrated Productivity Tools from Oracle Wind Software provide today's professionals with fast, versatile tools to import, analyze and display information with clarity and

TACOCIAN is an enhanced 1024 x 1024 resolution which integrates with popular OEM KIOSKS in UNIVERSITY, INFORMATION, and

and drivers graphic
and drivers graphic

for reports and presentations using data from TACTICIAN-DAMS or evaluation files.

Integrated Productivity Tools were designed with the OEM in mind to allow for quick, easy installation into problem solving applications. IPT is available today for NCR TOWER 2632 and LEXXUS P/35 installations. Additional IPT parts are currently in development.

Call for further information about the fast,
easy and powerful Integrated Productivity
Tools family.

SOUTHWIND SOFTWARE, INC.
4520 E. 47th St. Ste.
Wichita, Kansas 67216
316-788-2337
1-800-346-3025 (DST 24)

while it was transferring. Thus, control could not be returned to the user nor, in fact, could general system code be executed with the disk mounted. The interrupt routines for the clock and terminals, which needed to be runnable at all times, had to be coded in very strange fashion to avoid indirection.

Process control

By "process control," I mean the mechanisms by which processes are created and terminated. The system calls "fork," "exec," "exit," and "exit" implement these mechanisms. Unlike the file system, which existed in nearly its present form from the earliest days, the process control scheme underwent considerable mutation after PDP-7 Unix was already in use. (The introduction of path names in the PDP-11 system was certainly a considerable notational advance but not a change in fundamental structure.)

Today, the way in which commands are executed by the shell can be summarized as follows:

1. The shell reads a command line from the terminal.
2. It creates a child process by "fork."
3. The child process uses exec to call in the command from file.
4. Meanwhile, the parent shell uses "wait" to wait for the child (command) process to terminate by calling exit.
5. The parent shell goes back to step 1.

Processes (independently executing entities) existed very early in PDP-7 Unix. There were, in fact, precisely two of them, one for each of the two terminals connected to the machine. There was no fork, wait or exec. There was an exit, but its meaning was rather different, as will be seen. The main loop of the shell went as follows:

1. The shell closed all its open files, then opened the terminal special file for standard input and output (file descriptors 0 and 1).

2. It read a command line from the terminal.

3. It linked to the file specifying the command, opened the file and removed the link. Then it copied a small bootstrap program to the top of memory and jumped to it. This bootstrap program read in the file over the shell code, then jumped to the first location of the command (in effect an exec).
- 4) The command did its work, then terminated by calling "exit." The exit call caused the system to read in a fresh copy of the shell over the terminated command, then to jump to its start (and thus in effect to go to step 1).

The most interesting thing about this primitive implementation is the degree to which it anticipated themes developed more fully later. True, it could support net-

ther background processes nor shell command files (let alone pipes and filters); but I/O redirection (via "<" and ">") was soon there; it is interesting to note that the mechanism of redirection was quite straightforward; in step 3 above, the shell just replaced its standard input or output with the appropriate file. Crucial to subsequent development was the implementation of the shell as a user-level program stored in a file, rather than a part of

the operating system.

The structure of this process control scheme, with one process per terminal, is similar to that of many interactive systems, for example Multics, Honeywell TSS and IBM TSS and TSO. In general, such systems require special mechanisms to implement useful facilities such as detached computations and command files; Unix at that stage didn't bother to supply the special mechanisms.

It also exhibited some irritating, idiosyncratic problems. For example, a newly re-created shell had to close all its open files both to get rid of any open files left by the command just executed and to reclaim previous I/O redirection. Then it had to re-open the special file corresponding to its terminal in order to read a new command line. There was no "/dev" directory (because no path names).

Moreover, the shell could

retain no memory across commands because it was re-executed afresh after each command. Thus, a further file system convention was required: every directory had to contain an entry "0" for a special file that referred to the terminal of the process that opened it. If by accident one changed into some directory that lacked this entry, the shell would loop hopelessly, and just about the only remedy was to reboot. (Sometimes the missing link



IF IT WEREN'T FOR UNIX WE NEVER COULD HAVE BUILT THE PYRAMIDS

Ordinary computers, yes. But not a Pyramid Technology 90x.

After all, here's a supermini—not just capable of running UNIX™ but born to run it. And run it up to four times faster than the most popular UNIX host. For a lot less money.

The secrets of this Pyramid are a thorough understanding of UNIX, a few fundamentals of RISC (Reduced Instruction Set Computer) theory, more registers than 30 VAXes, and a 32-bit proprietary architecture that outperforms a roomful of micros. All combined to speed up UNIX just where it likes to slow down.

For example, gone are 85% of performance-robbing memory references. The endless parameter shuffling of yesterday's technology has been replaced with a hardware register window. Even context switching takes less than one percent of the CPU's time.

It's amazing what hardware architects can do, given the chance. It's almost as startling as what our software wizards did.

They crafted OS4, a dual port of Berkeley's 4.2 BSD and Bell's System V. Because you can switch environments at will, no UNIX port offers more capabilities. With absolutely no loss.

of compatibility.

Well, almost.

We do admit to one feature not compatible with other UNIX systems. Our single-source support.

One telephone number instantly connects you to both hardware and software experts. In-house pros, who spend their energy pointing you towards solutions. Not pointing fingers at each other.

So no matter how you see your requirements shaping up, contact Pyramid Technology, 1256 Charleston Road, Mountain View, California 94043. Or call (415) 965-7200.

Because when it comes to running UNIX, a Pyramid looks good from any angle.

**PYRAMID
TECHNOLOGY**

could be made from the other terminal.)

Process control in its modern form was designed and implemented within a couple of days. It is astonishing how easily it fit into the existing system. At the same time, it is easy to see how some of the slightly unusual features of the design are present precisely because they represented small, easily coded changes to what existed.

A good example is the separation of the fork and exec functions. The most common model for the creation of new processes involves specifying a program for the process to execute. In Unix, a forked process continues to run the same program as its parent until it performs an explicit exec. The separation of the functions is certainly not unique to Unix; and, in fact, it was present in the Berkeley time-sharing system, which was well-known to Thompson.

Still, it seems reasonable to suppose that it exists in Unix mainly because of the ease with which fork could be implemented without changing much else. The system already handled multiple (two) processes; there was a process table, and the kernel had the ability to swap main memory and the disk. The initial implementation of fork required only:

1. Expansion of the process table.
2. Addition of a fork call that copied the current process to the disk swap area, using the already existing swap I/O primitives, and made some adjustments to the process table.

In fact, the PDP-7's fork call required only 27 lines of assembly code. Of course, other changes in the operating system and user programs were required, and some of these were rather interesting and unexpected. But a combined fork-exec would have been considerably more complicated, if only because exec, as such, did not exist. Its function was already performed, using explicit I/O, by the shell.

The original system call, which previously read in a bare copy of the shell (actually a sort of automatic exec but without arguments), simplified considerably; in the new version, a process only had to clean out its process table entry and give up control.

Curiously, the primitives that became "wait" were considerably more

By the beginning of 1970, PDP-7 Unix was a going concern. Primitive by today's standards, it was still capable of providing a more congenial programming environment than its alternatives.

general than the present scheme. A pair of primitives sent one-word messages between named processes:

```
smes(pid, message)
(pid, message = rmes)
```

The target process of smes did not need to have any ancestral relationship with the receiver, although the system provided no explicit mechanism for communicating process IDs, except that fork returned to each of the parent and child the ID of its relative. Messages were not queued; a sender delayed until the receiver read the message.

The message facility was used as follows: The parent shell, after creating a child, would send a message to the new process by name. When the command terminated (assuming it did not try to read any messages), the shell's blocked smes call returned an error indication that the target process did not exist. Thus, the shell's smes became, in effect, the equivalent of "wait."

A different protocol, which took advantage of more of the generality offered by smes, was later developed between the initialization program and the shells for each terminal: The initialization process, whose ID was understood to be 1, created a shell for each of the terminals and then issued "rmes"; each shell, when it read the end of its input file, used smes to send a conventional "I am terminating" message to the initialization process, which re-created a new shell process for that terminal.

I can recall no other use of messages. This explains why the facility was replaced by the wait call of the present system, which is less general but more directly applicable to the desired purpose. Possibly relevant also is the evident bug in the mechanism: If a command process attempted to use messages to communicate

with other processes, it would disrupt the shell's synchronization. The shell depended on sending a message that was never received; if a command executed rmes, it would receive the shell's "go away" message and the shell would read another input line just as if the command had terminated. If a need for general messages had manifested itself, the bug would have been repaired.

At any rate, the new process control scheme instantly rendered some very useful features trivial to implement: for example, detached processes (with "A") and recursive use of the shell as a command. Most systems have to supply some sort of special "background job" mechanism and a special command interpreter for files distinct from the one used interactively.

Although the multiple-process idea slipped in very easily indeed, there were some sideeffects that weren't anticipated. The most memorable of these became evident soon after the new system came up and apparently worked. In the midst of our

jubilation, it was discovered that the "chdir" (change current directory) command had stopped working. There was much reading of code and anxious introspection about how the addition of fork could have broken the chdir call.

Finally the truth dawned: the old-style chdir was an ordinary command; it adjusted the current directory of the (unique) process attached to the terminal. Under the new system, the chdir command correctly changed the current directory of the process created to execute it, but this process promptly terminated and had no effect whatever on its parent shell. It was necessary to make chdir a special command executed interactively within the shell. It turns out that several command-like functions have the same property, for example, "login."

Advent of the PDP-11

By the beginning of 1970, PDP-7 Unix was a going concern. Primitive by today's standards, it was still capable of providing a more congenial programming environment than its alternatives. Nevertheless, we knew that the PDP-7, though we didn't exactly consider it obsolete, and its successors in the same line offered little of interest.

In early 1970, we proposed acquisition of a PDP-11, which had just been introduced by DEC. In some sense, this proposal was merely the latest in the series of attempts that had been made throughout the preceding year. It differed in two important ways. First, the amount of

Computerworld/Espana makes talking to the Spanish computer market easy.

Spain has become a major and fast-growing market for U.S. exporters. There are currently 4,000 personal computers and over 3,000 business computers in Spain, with a value of \$2.2 billion. In addition, there are more than 11,000 office computers in operation. Industry revenues are increasing 20% to 30% yearly, contributing to Spain's GNP growth of 9% annually for the last three years. To meet this growing demand for EDI equipment, products and services, computer professionals read Computerworld/Espana when they look to buy. Computerworld/Espana is the only EDI newspaper serving the Spanish data processing market. Read after the older publications, Computerworld/Espana is a uniquely suited vehicle for reaching up-and-coming buyers for EDI professionals and companies who want to keep informed on the fastest growing industry in the area. And now, Computerworld/Espana makes its mailing list of 9,000 EDI and MIS executives available for rental. This is a unique opportunity to test your product or service in this burgeoning market.



For further information on advertising in Computerworld/Espana or its mailing list, just fill out the coupon below.

Why don't we run under UNIX™?



With Unix you could take advantage of a rapidly growing market and the acclaimed C programming language. Our Translations Technology Group makes Unix conversions child's play. No matter what high-level language your system is written in, we will deliver a warranted, maintenance version for any Unix system you choose. Call Scott Wilson at 412-621-2277 today to find out how fast and easy conversions can be with our portable automated translation tools.

UNILOGIC

UniLogic, Ltd.
160 North Craig Street
Pittsburgh, PA 15213

UNILOGIC is a trademark of Bell Laboratories.

Diana La Plante, Manager
International Publishing Services
CW Communications Inc.
375 Commonwealth Road, Box 880
Princeton, NJ 08541
(609) 457-0700

Please send me more information on
 Computerworld/Espana Your other foreign publications

Name _____ Title _____
 Company _____
 Address _____
 City _____ State _____ Zip _____



CW COMMUNICATIONS INC.
Publishers of Computerworld and other
leading computer publications around the world

money (about \$65,000) was an order of magnitude less than what we had previously asked; second, the charter sought was not merely to write some (unspecified) operating system, but instead to create a system specification for editing and formatting text, which today be called a word processing system.

The impetus for the proposal came mainly from J.P. Osmana, who was then and until the end of his life interested in text processing. If our early proposals were too vague, this one was perhaps too specific; at first it, too, met with disfavor. Before long, however, funds were obtained through the efforts of L.E. McFaulon, and an order for a PDP-11 was placed in May.

The processor arrived at the end of the summer, but the PDP-11 was so new a product that no disk was available until December. In the meantime, a rudimentary, core-only version of Unix was written using a cross-assembler on the PDP-7. Most of the time, the machine sat in a corner, enumerating all the closed knight's moves on a 6x6 chess board — a three-month job.

Once the disk arrived, the system was quickly completed. In internal structure, the first version of Unix for the PDP-11 represented a relatively minor advance over the PDP-7 system; writing it was largely a matter of transliteration. For example, there was no multiprogramming; only one user program was present in core-at any moment.

On the other hand, there were important changes in the interface to

Not only did the patent department adopt Unix, but we achieved enough credibility to convince management to acquire one of the first PDP-11/45s.

the user. The present directory structure, with full path names, was in place, along with the modern form of "exec" and "wait" and conveniences like character-oriented and block I/O procedures for terminals. Perhaps the most interesting thing about the enterprise was its small size: 34K bytes of core memory (14K for the system, 8K for user programs) and a disk with 1K blocks (512K bytes). Files were limited to 64K bytes.

At the time of the placement of the order for the PDP-11, it had seemed natural, or perhaps expedient, to promise a system dedicated to word processing. During the protracted argument over the specification, the usefulness of PDP-7 Unix made it appropriate to justify creating PDP-11 Unix as a development tool, to be used in writing the more special-purpose system.

By the spring of 1971, it was generally agreed that no one had the slightest interest in scrapping Unix. Therefore, we transliterated the "roff" text formatter into PDP-11 assembler language, starting from the PDP-7 version that had been transliterated from McIlroy's BCPL version

on Multics, which had in turn been inspired by J. Saltzer's "runoff" program on CTSS.

In early summer, editor and formatters in hand, we felt prepared to fulfill our original obligation to supply a text processing service to the patent department for preparing patent applications. At the time, they were evaluating a commercial system for this purpose. The main advantages we offered (besides the dubious one of taking part in an in-house experiment) were two in number.

First, we supported Teletype Corp.'s Model 37 terminals, which, with an extended type-base, could fulfill most of the needs. Second, we quickly endowed ruff with the ability to produce line-numbered pages, which the Patent Office required and which the other system could not handle.

During the last half of 1971, we supported three typists from the patent department — who spent the day busily typing, editing and formatting patent applications — and meanwhile tried to carry on our own work. Unix has a reputation for supplying interesting services on modest hard-

ware, and this period may mark a high point in the benefit/equipment ratio. On a machine with no memory protection and a single .5M-byte disk, every test of a new program required a cold boot, and because it could easily fill the system, and every few hours' work to the typists meant pushing out more information onto DECtape because of the very small disk.

The experiment was trying but successful. Not only did the patent department adopt Unix, and thus become the first of many groups at the Laboratories to fully own and achieve sufficient credibility to convince their own management to acquire one of the first PDP-11/45 systems made. We have accumulated much hardware since then and labored continuously on the software.

Introducing pipes

One of the most widely admired contributions of Unix to the culture of operating systems and command languages is the "pipe," as used in a pipeline of processes. Of course, the fundamental idea was not new; the pipe-line is merely a specific form of co-routine. Even the implementation was not unprecedented, although we didn't know it at the time. The "communication files" of the Dartmouth Time-Sharing System did very nearly what Unix pipes do, though they seem not to have been exploited so fully.

Pipes appeared in Unix in 1975, well after the PDP-11 version of the system was in operation, at the suggestion (or perhaps insistence) of

Quotron Systems, Inc. is an industry leader, supplying on-line financial information services to more than 65,000 customer terminals in over 5,700 locations in the U.S. and throughout the world. Our customers include major companies that have created unique career opportunities for the following individuals:

UNIX/C Instructor, Instructional Design

This position in our Customer Support and Training Dept. requires a minimum of 5 years experience with UNIX/C and/or assembly language and internal technical training. In addition, the qualified candidate will have software application coursework design and development experience.

Programmer

We are looking for an individual with a strong background in personal computers and microcomputers to work on a variety of personal computers in the prototyping of applications.

Project Managers

You will manage various company projects in the area of software and system development. Responsibilities include assuming leadership in monitoring, tracking and reporting project progress/status to senior management and assisting with the development of project plans. You must have excellent communication skills and a background that includes networks, data processing and real-time systems. Management and excellent communication skills required; brokerage and UNIX experience a plus.

Sr. Proposal Development Analyst

An excellent advancement and growth opportunity exists for a proposal specialist to develop custom proposals. Familiarity with on-line, data communications, data base management and office automation systems required. You must have good organizational and technical writing skills, excellent communication skills, good direction and have the ability to interface with senior level management. Brokerage/banking and UNIX experience a plus.

We also have openings for Software Designers, Database Network Designers, Technical Writers, Technical Instructors and Sr. Systems Analysts.

We offer competitive salaries, excellent benefits and a pleasant working environment in the Los Angeles area. For immediate consideration, please send resume, with salary history to: Human Resources Dept., Quotron, 1000 W. Olympic Blvd., CH 9026, P.O. Box 66114, 5444 Beethoven St., Los Angeles, CA 90065.

Equal Opportunity Employer

**QUOTRON
SYSTEMS,
INC.**

Quotron

UNIX, C & You . . .

Technologies such as UNIX and C provide a valuable resource for meeting data processing needs. But, your most valuable investment lies in your knowledge of how to use these tools effectively and efficiently.

At NCR our business is providing you with the technology to satisfy your information needs. And, with UNIX and C, and our C and UNIX courses, we believe we are providing you with the resources to harness that technology — YOUR KNOWLEDGE. In the past 10 years alone we have trained over 100,000 students in every aspect of data processing and completed over half-a-million days of instruction.

To the UNIX and C user we provide a full curriculum of hands-on training designed to meet the needs of Programmers, System Administrators, Operators and Managers.

	UNIX Operating System	UNIX System Administration	C Programming
Length	5 days	3 days	5 days
Time	\$960	\$570	\$960
Chicago	Aug 20 Oct 5 Dec 3	Oct 15	Sept 24 Nov 5
Dallas	Sept 10 Dec 5	Sept 17 Dec 10	Nov 12
Dayton	Aug 15 Sept 10 Dec 3	Sept 24 Oct 29 Dec 17	Aug 26 Sept 17
Los Angeles	Oct 8	Oct 15	
New York	Oct 1 Nov 26		Nov 5 Dec 10
Houston	Oct 22	Oct 29	

ENROLL TOLL FREE
NCR
(or call to receive a UNIX information packet)
1-800-848-CASE
(Ohio 1-800-841-CASE)



Confirmation of enrollment will be made upon receipt of purchase order or check by A/R memo. Refundable up to seven calendar days prior to start of class.

UNIX is a trademark of Bell Laboratories.

... together

McIlroy, a long-time advocate of the nonhierarchical control flow that characterizes co-routines. Some years before pipes were implemented, he suggested that commands should be thought of as binary operators whose left and right operand specified the input and output files. Thus, a "copy" utility would be commanded by:

`inputfile copy outfile`

To make a pipeline, command operators could be stacked up. Thus, to sort & input, paginate it neatly and print the result off-line, one would write:

`inputfile sort paginate offprint`

In today's system, this would correspond to:

`sort inputfile | paginate`

The idea, explained one afternoon

on a blackboard, intrigued us but failed to ignite any immediate action. There were several objections to the idea as put: The infix notation seemed too radical (we were too accustomed to typing "cp x y" to copy x to y); and we were unable to see how to distinguish command parameters from the input or output files. Also, the one-input, one-output model of command execution seemed too confining. What a failure of imagination!

Some time later, thanks to McIlroy's persistence, pipes were finally installed in the operating system.

High-level languages

Every program for the original PDP-7 Unix system was written in assembly language, and bare assembly language it was — for example, there were no macros. Moreover, there was no loader or link editor, so

every program had to be complete in itself. The first interesting language to appear was a version of McGuire's TMG that was implemented by McIlroy. Soon after TMG became available, Thompson decided that we could not pretend to offer a real computing service without Fortran, so he sat down to write a Fortran in TMG. As I recall, the intent to handle Fortran lasted about a week. What he produced instead was a definition of a compiler for the assembly language. B was much influenced by the BCPL language. Other influences were Thompson's taste for spartan syntax and the very small space into which the compiler had to fit. The compiler produced simple interpretive code. Although it and the programs it produced were rather slow, it made life much more pleasant. Once interfaces to the regular system

calls were made available, we began once again to enjoy the benefits of using a reasonable language to write what are usually called "systems programs" — compilers, assemblers and the like. (Although some might consider the PL/I we used under Unix unreasonable, it was much better than assembly language.) Among other programs, the PDP-7 B cross-compiler for the VAX was written in B. In the course of time, the B compiler for the PDP-7 itself was transferred from TMG into B.

When the PDP-11 arrived, B was moved to it almost immediately. In fact, a version of the multiprecision "desk calculator" program "dc" was one of the earliest programs to run on the PDP-11, well before the disk arrived. However, B did not take over instantly. Only passing thought was given to rewriting the operating system in B. The C language had the same was true of most utilities. Even the assembler was rewritten in assembler. This approach was taken mainly because of the slowness of the interpretive code. Of smaller but still real importance was the mismatch of the word-oriented B language with the byte-addressed PDP-11.

Thus, in 1971 work began on what was to become the C language. Perhaps the most important watershed occurred during 1972, when the existing system kernel was rewritten in C. It was at this point that the system assumed its modern form; the most far-reaching change was the introduction of multiprogramming. There were few externally visible changes, but the internal structure of the system became much more rational and general. The success of this effort convinced us that C was useful as a nearly universal tool for systems programming, instead of just a toy for simple applications.

Today, the only important Unix programs still written in assembler is the assembler itself; virtually all the utility programs are in C and so are most of the application programs, although there are sites with many in Pascal, Pascal and Algol 68 as well. It seems certain that much of the success of Unix follows from the readability, modifiability and portability of its software that in turn follows from its expression in high-level languages.

One of the comforting things about old memories is their tendency to take on a rosy glow. The programming environment provided by the early versions of Unix seems, when described here, to be extremely harsh and primitive. I am sure that if forced back to the PDP-7, I would find it intolerably limiting and lacking in conveniences. Nevertheless, it did not seem so at the time. The memory fixes on what was good and what lasted and on the joy of helping to build something that made people's life better. In 10 years, I hope we can look back with the same mixed impression of progress combined with continuity.

I am grateful to S.P. Morgan, K. Thompson and M.D. McIlroy for providing early documents and digging up recollections.

Because I am most interested in describing the evolution of ideas, this article emphasizes ideas and work to individuals only when they are most important. The reader will not, on the average, go far wrong if he reads each occurrence of "we" with unclear antecedent as "Thompson, with some assistance from me."

tcc

It may become your favorite UNIX command.

TARTAN's C Compiler: compatibility across machines and highly optimized code—to save you resources. Superior error reporting, complete documentation, and responsive product support—to save you time.

tmc

It may become another favorite UNIX command.

TARTAN's Modula-2 Compiler: the language Pascal wishes it could be—structured syntax, separate compilation, concurrent processing support. With TARTAN's high quality performance, error handling, and support.

Your Favorite Compilers— Save You Time and Resources

- Optimized Code: Fit more application on your machine; lets it execute faster. You'll get more work done with your present machines.
- Superior Compile-time Diagnostics: Minimize recompiles. Locate errors precisely. Reduce the hours needed to produce a correct program.
- Compatibility: Keep up with a changing world. Mix languages in an application. Add new machines, and compile your existing programs correctly. TARTAN's technology produces compatible compilers without sacrificing optimization. Start with TARTAN compilers and grow with them—compatibly.
- Complete Documentation: Answers to the questions that always arise. Complete examples and suggested actions for every compiler message. Your people adapt to TARTAN compilers quickly, and save time every day.
- Responsive Product Support: Your time is important. Take your questions and problems to our support service team. You get the answers when you need them.

TARTAN C and Modula-2 compilers for VAX/VMS/UX. To place your order, call our end user Sales Department at 412-621-2212, or write us at the address below.

TARTAN compilers are part of a new generation of highly-optimizing compilers that improve application program performance and make programmers more productive. We're sure you'll agree.

TARTAN—
We're going to be your favorite software company.

VAX is a trademark of Digital Equipment Corporation.
OS/2 is a trademark of IBM Corporation.

TARTAN

Tartan Laboratories, Inc.
177 Metzler Road, Dept. 100
Pittsburgh, PA 15237
(412) 621-2212

AFTER SYSTEM V

C



The sheer size of Unix precludes its use as a truly universal operating system unless you remove personal computers from the universe.

in 1969. While Unix has undergone many substantial revisions and is an extremely stable and mature system, it is now 15 years old — almost ancient technology.

Unix was initially designed for one purpose: to be a hospitable environment for programmers who would know how to exploit its strengths and avoid its weaknesses. Now it is being touted as the perfect system for any and all business applications.

But no one operating sys-

tem is perfect for everyone, just as no one programming language has ever proved ideal for all purposes. Many in the computer industry forget the lessons of the past, notably the one that states, "People will not put up with unusable systems if something better is available."

Remember when everyone used punched cards for input and batch processing was the order of the day? Now we pay more attention to people's efficiency than the com-

puter's and user interactive, CPT-based systems whenever possible. The Unix system is based on this philosophy, making work easier if you understand the principles.

But Unix is much more complex than other operating systems in wide use. While it is true that Microsoft Corp.'s MS-DOS and Digital Research, Inc.'s CP/M are far from the ideal user environment (and are limited in features, besides), they have the advantage of being simpler for a novice user to learn.

When comparing a full-blown system such as Unix to MS-DOS, it is important to remember that the latter is not a leading operating system because of its technically better features or even because it is easier to use. MS-DOS is an industry leader solely because of its association with the IBM Personal Computer (one might even consider that the Commodore 64 operating system is an industry leader for the same reason).

While several factors make the IBM Personal Computer a best-seller, remember that people tend to buy computers for solutions to their problems, not for the sheer joy of using them. They are caring for their very own machine. People generally buy the IBM Personal Computer with MS-DOS because they can then easily run some of the thousands of good application programs that exist for it. To them, the only purpose of the operating system is to allow the use of the application program, the joy to use the system.

Prediction: End users will not buy Unix-based systems in large quantities until they are convinced that such systems and their application programs offer significant advantages over other available machines. Furthermore, they will require a high level of compatibility with personal computers now marketed.

What's the real problem? It's still not universally possible to order a Unix-based machine, read a short introductory manual, then turn it on and begin using it.

It's still not possible to go down to your local software store and buy an application program on a disk that can be dropped into your Unix system and poof! — it's installed.

It's still necessary to go through a long learning process to use Unix efficiently and an even longer one to manage the system adequately.

MS-DOS is not perfect in these three areas either, but facts and popular perception often differ.

The sheer size of Unix precludes its use as a truly universal operating system unless you remove personal computers from the universe. Unix has become such a large

Now Gould offers the widest range of UNIX-based systems in the world.



GOULD
Systems

COMPUTERWORLD



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 709 FRAMINGHAM, MA 01701

postage will be paid by

CIRCULATION DEPARTMENT

COMPUTERWORLD

375 Cochituate Road, Rte. 30
Box 897
Framingham, MA 01701-9985

system (it includes not only the kernel, or executable program called Unix, but also about 7M bytes of utility programs) that the last supposedly "frozen" release from AT&T has already been supplanted by System V, Release 2, because of the numerous bug fixes and upgrades added.

System V does have many additions that make work easier for the system administrator and advanced user. Even so, current Unix System V does not include features such as record locking that are commonly implemented in commercial operating systems. This lack has helped competing systems with these features, notably Microsoft's Xenix, capture a large share of the market. Other systems have begun to emerge as important market forces, most of them like Xenix, blatantly derived from Unix itself.

One, known as 4.2 BSD (written at the University of California at Berkeley), provides such performance over System V that it has become the de facto standard system on Digital Equipment Corp.'s VAX minicomputers. The University of Delaware's DECnet is also 4.2 BSD as the basis for its implementation of Unix (called Ultron). The 4.2 BSD system owes its speed to a technique known as "demand paging," which requires sophisticated hardware memory management. This hardware support, previously available only on machines such as the VAX, will become more common with the new generation of microprocessors.

More pressure is therefore on

UNIX SHOWS COMING UP

Here is a sample of major conferences scheduled for the next year that focus on Unix systems:

Oct. 16-18, 1984, Unix Expo at Marina Expo Complex and Sheraton Century Hotel, New York, sponsored by Unisgroup. Contact National Expositions, 14 West 40th St., New York, N.Y. 10018. Will combine technical and marketing focus in 300 exhibits as well as three program tracks geared to the nonhierarched end user.

Jan. 21-25, 1985. UnixForum at Dallas Infomart, sponsored by /usr/group, Suite 200, 4655 Old Ironsides Drive, Santa Clara, Calif. 95064. Or contact conference managers: Professional Exposition Management Co., Suite 205, 2400 East Devon Ave., Des Plaines, Ill. 60018. Two hundred companies expected in 750 booths. Three program tracks will cover Unix and micros, office systems and market trends.

Jan. 23-26, 1966, Usenix conference, Fairmont Hotel, Dallas; shuttle buses will link this conference to Uniforum exposition. Contact Judith Desharnais, Usenix Association Conference Office, P.O. Box 285, Sunset Beach, Calif.

June 11-14, 1985, Usenix Conference, Portland, Ore. Contact Judith Desharnais, Usenix Association Conference Office, P.O. Box 386, Sunset Beach, Calif. 90742.

The Berkeley version, known as 4.2BSD, provides such superior performance over System V that it has become the de facto standard on VAX machines running Unix.

AT&T to include features like demand paging and record locking in new releases. It was previously speculated that System V would support these features; now AT&T watchers hope that System VI will. For the past few years, AT&T has announced new releases of Unix in January, so we might not have long to wait to

find out.

Technical considerations aside, the key to making Unix more palatable as a "universal operating system" comes back to the user interface. The software vendors in the Unix arena have mainly addressed other, technophiles like themselves; few companies have made an effort

to put ease of use and ease of installation high on their priority list.

AT&T has great technical strength and a large trained sales force, so it can be expected to influence the quality of offerings eventually. Still, IBM's growing support of the Unix system — versions are now available for the IBM Personal Computer, IBM 9000, and mainframe computers — may prove to be the most significant factor in the business world's acceptance of Unix.

The best of both worlds



Now, software developers can expand their markets and increase their productivity with Co-Idris™, the newest UNIX-like operating system from Whitesmiths, Ltd.

Co-Idris is a professional, sophisticated tool enabling users to develop programs in a powerful and flexible UNIX-like environment, then easily port these applications to a wide range of PC/MS-DOS machines, including the IBM PC, DEC Rainbow, Wang PC, DG Desktop, and Olympia PC. With the Co-Idris package, you can construct C, Pascal, or assembler programs for operation under Co-Idris, DOS or CP/M-86.

Able to work in as little as 128 KB of total main memory, Co-Idris allows concurrent access to both Idris-based programs and PC- or MS-DOS based application programs. You get the multi-user, multi-tasking features of a UNIX environment as well as the rich selection of DOS applications. And there is no need to reboot DOS, ever.

Co-Idris works on most all PC/MS-DOS based configurations with hard disks, and it's available now!

Dealer Inquiries Invited



Whitesmiths, Ltd.

97 Lowell Road Concord, MA 01742 (617) 369-8498
Tlx 750246 SOFTWARE CMCW

INSTRUMENTS, Asahi Tech., Phoenix, Ky. 40021, 513/275-0100; Japan Advanced Data Controls Corp., Chelmsford, Mass. 01824, 508/226-0000; United Kingdom: Head Type Systems, Chingford, 100-100-2882; United States, Atlanta, Ga. 30339, 404/951-2990; Netherlands: A Division of Digital Equipment Corp. (DEC) in a joint venture with Unisys Corp.; France: A Division of Microsoft Corp. PC-GOES is a trademark of International Business Machines Corporation. © 1985.

